MARYLAND BIOLOGICAL STREAM SURVEY 2000-2004

VOLUME III
ECOLOGICAL ASSESSMENT OF WATERSHEDS SAMPLED IN 2002

CHESAPEAKE BAY AND
WATERSHED PROGRAMS
MONITORING AND
NON-TIDAL ASSESSMENT

CBWP-MANTA-EA-04-1

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The Maryland Department of Natural Resources (DNR) seeks to preserve, protect and enhance the living resources of the state. Working in partnership with the citizens of Maryland, this worthwhile goal will become a reality. This publication provides information that will increase your understanding of how DNR strives to reach that goal through its many diverse programs.

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MARYLAND BIOLOGICAL STREAM SURVEY 2000-2004

Volume III: Ecological Assessment of Watersheds Sampled in 2002

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FOREWORD

This report, *Maryland Biological Stream Survey 2000-2004, Volume III: Ecological Assessment of Watersheds Sampled in 2002,* supports the Maryland Department of Natural Resources' Maryland Biological Stream Survey (MBSS) under the direction of Dr. Ronald Klauda and Mr. Paul Kazyak of the Monitoring and Non-tidal Assessment Division. Versar's work and this report were prepared under Maryland's Power Plant Research Program (Contracts No. PR-96-055-001 and K00B0200109 to Versar, Inc.). A major goal of the MBSS is to assess the ecological condition of Maryland's streams, with a particular focus on biological resources, but also evaluating water chemistry and physical habitat. Round Two of the MBSS was designed to characterize and assess watersheds over a five year cycle (2000-2004). This annual report presents results from watersheds sampled in 2002. This report includes a history of the program, a description of methods and survey design, comparative assessments by watershed, detailed results for individual watersheds, and comparisons with Round One results (from 1995-1997).

ACKNOWLEDGMENTS

The 2002 MBSS has been a cooperative effort among several agencies and consultants. We at Versar wish to thank Ronald Klauda and Paul Kazyak from the Maryland Department of Natural Resources (DNR) for directing the program and supporting Versar in preparing this report. DNR and the University of Maryland's Appalachian Laboratory (AL) each provided field crews and did a great job collecting the data. DNR digitized watersheds and calculated land use data, provided quality assurance, conducted crew training, and performed field sampling. Tony Prochaska of DNR contributed to writing this report. Mark Southerland and Paul Kazyak served as its editors. Dr. Ray Morgan of the University of Maryland's Appalachian Laboratory supervised one field crew and oversaw water chemistry laboratory analysis. Dr. Rich Raesly of Frostburg State University provided taxonomic verifications of voucher fish specimens. Versar designed the sampling program, obtained landowners' permissions, conducted statistical analyses, and prepared this report.

The success of the project resulted from the strong efforts of all these groups. We particularly thank the key individuals listed below for their contributions:

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ABSTRACT

This report presents the results of sampling conducted in 2002 by the Maryland Biological Stream Survey (MBSS or the Survey) to assess the "state of the streams" throughout Maryland. The year 2002 was the third of five years of sampling planned for the second round of the Survey. Results for each year of Round Two will be reported annually and a summary report will be published when Round Two sampling is completed.

MBSS 2002 Results. In 2002, the Survey continued to provide invaluable information on the abundance and distribution of rare species. To support a more thorough understanding of Maryland's biodiversity. During MBSS sampling in 2002, a number of occurrences of rare fish were documented, including four state-listed rare species: mud sunfish, banded sunfish, swamp darter, and pearl dace.

The status of sampled watersheds and individual stream segments was assessed, focusing on the condition ratings of the fish and benthic Indices of Biotic Integrity (IBI), indicators previously developed by the Survey and employed in evaluating Round One results. IBI scores for each site were determined by comparing the fish or benthic assemblage to those found at minimally disturbed reference sites.

Fish IBI scores at sites sampled in the 2002 MBSS spanned the full range of biological condition, from 1.0 (very poor) to 5.0 (good). Mean fish IBI per PSU ranged from 1.96 (Potomac River Washington County PSU) to 3.85 (Eastern Bay PSU).

Benthic macroinvertebrate IBI scores spanned the range of biological conditions from 1.0 (very poor) to 4.71 (good). The lowest mean benthic IBI was 1.86 in the Lower Pocomoke. The highest mean benthic IBI was 4.06 in Savage River. Within-PSU variability ranged from low to high. The greatest extent of occurrence of streams with benthic IBI < 3 (expressed as 90% confidence intervals) was in the Lower Pocomoke and Back River PSUs (71 to 100% of stream miles).

In 2002, estimates of the percentage of stream miles sensitive to acidification (i.e., those with ANC < 200 μeq/l) followed the geographic pattern noted in the Maryland Synopic Stream Chemistry Survey (MSSCS) of 1987 and Round One MBSS, with the greatest extent of acid-sensitive streams in Western Maryland and the Southern Coastal Plain. Seven PSUs, primarily in the same regions, had sites highly sensitive to acidification (ANC < 50 μeq/l). Also paralleling the Round One results, acidic deposition effects were more widespread than effects (33 sites in 8 PSUs) from acid mine drainage (0 sites) or agriculture (4 sites in 2 PSUs).

A provisional Physical Habitat Index (PHI), developed using earlier MBSS data (Hall et al. 1999) was used to score sites sampled in 2002. PHI scores varied widely within and among PSUs. The mean PHI fell into the range of good in one PSU (Rocky Gorge Dam), while mean PHI was poor in one PSU (Back River) and fair in the remaining 17 PSUs. Stream mile estimates of the occurrence of poor to very poor PHI scores suggest that physical habitat degradation is widespread.

MBSS 2002 results indicate that stream channelization is common in some Maryland watersheds, particularly in the Coastal Plain. Moderate to severe bank erosion also occurs commonly in Maryland streams. Bank erosion contributes to sediment-related impacts locally, in tidal river downstream and ultimately in the Chesapeake Bay. Mean values by PSU were used to estimate the extent of eroded area (square meters) per stream mile. Highest values were in Loch Raven Reservoir, Conewago Creek/Double Pipe Creek, and Breton/St. Clements Bay PSUs. The combined area of eroded bank in all 19 PSUs totaled more than 610 acres. Exacerbated bar formation was observed in most watersheds sampled in 2002. Lack of riparian vegetation on at least one stream bank was observed within 13 of 19 PSUs. Exotic plants, such as multiflora rose, mile-a-minute, and Japanese honeysuckle was present along stream sites in most watersheds. The total number of instream pieces of woody debris and rootwads was highest in the Jones Falls and Loch Raven Reservoir PSUs.

In Maryland, concern for nutrient loadings to the Chesapeake Bay has drawn attention to the amounts of nitrogen and phosphorus transported throughout the watershed by streams. In MBSS 2002 sampling, total nitrogen tended to be highest on the Eastern Shore. In general, nitrate nitrogen made up the largest fraction of total nitrogen. Nitrate nitrogen concentrations greater than 1 mg/l are commonly considered to indicate anthropogenic influence; mean nitrate nitrogen concentrations exceeded this level in 15 of 19 PSUs. In several PSUs, nearly 100% of stream miles had high nitrate nitrogen concentrations. Total phosphorus tended to be substantially higher on the Eastern Shore, lower in Western Maryland, and moderate in the central part of the state.

Management Implications and Future Directions. The information being obtained by Round Two of the MBSS

will continue to support a wide array of management decisions by Maryland DNR and other agencies. Major initiatives that have or will benefit from MBSS data include the new 2000 Chesapeake Bay Agreement, Maryland Land Conservation, Clean Water Action Plan, State water quality standards, Maryland biodiversity, and other local monitoring programs.

EXECUTIVE SUMMARY

This report presents the results of sampling conducted in 2002 by the Maryland Biological Stream Survey (MBSS or the Survey) to assess the "state of the streams" throughout Maryland. The year 2002 was the third of five years of sampling planned for the second round of the Survey. Results for each year of Round Two will be reported annually and a summary report will be published when Round Two sampling is completed.

Background. Supported and led by the Maryland Department of Natural Resources (DNR), the MBSS is a comprehensive program to assess the status of biological resources in Maryland's non-tidal streams; quantify the extent to which acidic deposition affects critical biological resources in the state; examine which other water chemistry, physical habitat, and land use factors are important in explaining stream conditions; provide a statewide inventory of stream biota; establish a benchmark for long-term monitoring; and target future local-scale assessments and mitigation measures needed to restore degraded biological resources. To meet these and other objectives, the Survey has established a list of questions of interest to environmental decision makers that guide its design, implementation, and analysis. These questions fall into three categories: (1) characterizing biological resources and ecological conditions (such as the number of stream miles with pH < 5), (2) assessing their condition, and (3) identifying likely sources of degradation.

To answer these questions, a number of steps have been taken since the Survey's inception, including (1) devising a sampling design, (2) field testing sampling protocols and logistics to assure data quality and precision, (3) conducting an extensive, multi-year field sampling program, (4) developing reference-based indicators of biological integrity, and (5) using analytical methods to evaluate contributions of different anthropogenic stresses, including land use. Sampling is probability-based (i.e., randomized), allowing accurate and robust population estimates of variables and sampling variance, so that estimates of status can be made with quantifiable confidence. In addition, the Survey focuses on biological responses to stress, but also collects data to characterize pollutant stress and habitat condition. Third, its scale is watershed-wide and statewide, rather than local.

MBSS Round Two Design. 2002 was the third year of sampling for Round Two of the Survey. Round Two includes both (1) a core survey based on statewide sampling of random stream segments and (2) ancillary sampling dedicated to additional monitoring and special studies. The core survey produces the majority of MBSS results and is the focus of this report. Some information gathered by the ancillary sampling is included, but extensive data analysis of these additional results is reserved for separate reports.

To meet the State's growing need for information at finer spatial scales, Round Two's core survey was redesigned to focus on Maryland's 8-digit watersheds (averaging 75 mi^2 in area) rather than drainage basins (averaging 500 mi^2). The Round Two design is based on first- through fourth-order, non-tidal streams on a new 1:100,000-scale base map. The study design allows estimates at the level of 84 individual or combined Maryland 8-digit watersheds that serve as primary sampling units (PSUs). Each PSU has 10 or more sample sites. To achieve this sample density while sampling approximately 210 sites each year, Round Two will take five years to complete, running from 2000 through 2004 (rather than the three years in Round One, 1995-1997).

The MBSS uses a probability-based survey design called lattice sampling to schedule sampling statewide over a multi-year period. The lattice design of Round Two stratifies by year and PSU, and restricts the sampling each year to about one-fifth of the state's 138 watersheds. Approximately 300 stream segments (210 in the core survey) of fixed length (75 m) are sampled each year, with biological, chemical, and physical parameters measured at each segment using standardized methods. Biological measurements include the abundance, size, and individual health of fish; taxa composition of benthic macroinvertebrates; and presence of amphibians, reptiles, mussels, and aquatic vegetation. Chemical analytes include pH, acid-neutralizing capacity (ANC), nitrogen, phosphorus, sulfate, chloride, conductivity, dissolved oxygen (DO), and dissolved organic carbon (DOC). Physical habitat parameters include commonly used observational measurements such as instream habitat structure, embeddedness, pool and riffle quality, shading, and riparian vegetation, as well as quantitative measurements such as stream gradient, maximum depth, wetted width, and discharge. Channelization, bank erosion, bar formation, and land use immediately visible from the segment are assessed. Additional land use data for the entire catchment upstream of each sample site are incorporated from statewide geographic information system (GIS) coverages.

For the most part, methods used in Round Two are identical to those of Round One. However, some changes were made to improve the quality and/or usefulness of the data generated. These changes in sampling methods include (1) modifications to habitat assessment and characterization, (2) the addition of new chemical analytes (total dissolved nitrogen, total particulate nitrogen, nitrite nitrogen, ammonia, ortho-phosphate, total dissolved phosphorus, total particulate phosphorus, chloride, and turbidity), (3) collection of continuous temperature readings in the summer, (4) characterization of invasive plant abundance, and (5) the addition of altitude as a physical variable. In addition, the reach file used to select sites is the USGS 1:100,000-scale map; this is a change from the 1:250,000-scale map used in Round One, meaning that more small streams will be sampled in Round Two. Another change to the sample frame is the inclusion of fourth-order streams.

Although the Survey will provide the data needed to characterize the status of all 8-digit watersheds, it will not have sufficient sampling density to characterize most of the 1066 12-digit subwatersheds. Therefore, Round Two of the MBSS has been expanded to include coordination with volunteer efforts (such as DNR's Maryland Stream Waders) and County stream monitoring programs. Ultimately, by incorporating these data, the MBSS hopes to better characterize many areas of the state at this finer spatial scale.

In addition to improving the spatial intensity of sampling, Round Two will address temporal variability by regular monitoring of fixed "sentinel" sites. In 2000, DNR established a network of approximately 25 sentinel sites deemed to be minimally impacted by human activities, in areas where land uses were unlikely to change over time (e.g., state parklands). With some modifications, these sites were again sampled in 2002, and will continued to be sampled throughout Round Two.

In 2002, 19 PSU's containing 219 sites were sampled. Ancillary sampling was conducted in 2002 to support Carroll County with three new sites in the Liberty Reservoir watershed.

MBSS 2002 Results. In 2002, the Survey continued to provide invaluable information on the abundance and distribution of rare species. To support a more thorough understanding of Maryland's biodiversity. During MBSS sampling in 2002, a number of occurrences of rare fish were documented, including four state-listed rare species: mud sunfish, banded sunfish, swamp darter, and pearl dace.

The status of sampled watersheds and individual stream segments was assessed, focusing on the condition ratings of the fish and benthic Indices of Biotic Integrity (IBI), indicators previously developed by the Survey and employed in evaluating Round One results. IBI scores for each site were determined by comparing the fish or benthic assemblage to those found at minimally disturbed reference sites.

IBI data for each PSU are depicted in box-and-whisker plots and mean IBIs for PSUs sampled in 2002 were mapped. Over the next two years of Round Two sampling, data will be collected in remaining PSUs to complete an updated statewide picture of biological conditions. Data were also used to estimate the extent of streams in poor to very poor condition (IBI < 3) within each PSU. The MBSS Round Two study design, based on simple random sampling, makes it possible to calculate an exact confidence interval around each estimate based on the binomial distribution. The extent of streams within a given condition (e.g., IBI < 3) is expressed as a percentage of all first- through fourth-order stream miles in the PSU, with an associated 90% confidence interval around the estimate.

The indicators used were developed during Round One of the MBSS and have been deemed reliable for representing ecological condition by field verification and expert peer review. Nonetheless, the Survey continues to pursue refinements to its indicators including improvements to the provisional physical habitat index (PHI), methods for combining indicators that do not lose information (e.g., combined biotic index), and changes to the indicator thresholds and scoring methods to make them more intuitive and accessible to the public.

Fish IBI scores at sites sampled in the 2002 MBSS spanned the full range of biological condition, from 1.0 (very poor) to 5.0 (good). Mean fish IBI per PSU ranged from 1.96 (Potomac River Washington County PSU) to 3.85 (Eastern Bay PSU).

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To integrate the results of fish and benthic IBI assessments, a Combined Biotic Index (CBI) was calculated as the mean of the fish and benthic IBI values at a site. If only one score was available (e.g., benthic IBI but no fish IBI) the single score was assigned as the CBI. CBI scores from core MBSS sites ranged from 1.00 (very poor) to 4.71 (good). Mean CBI per PSU ranged from 1.96 (Lower Pocomoke) to 3.77 (Savage River), paralleling the benthic IBI results.

The effects of acidic deposition and acid mine drainage (AMD) on stream chemistry are well documented. Round One MBSS results (Roth et al. 1999) and an assessment of these results in comparison with critical loads (Miller et al. 1998) confirmed that stream acidification remains a problem in Maryland freshwater streams. In 2002, estimates of the percentage of stream miles sensitive to acidification (i.e., those with ANC < 200 μeq/l) followed the geographic pattern noted in the Maryland Synopic Stream Chemistry Survey (MSSCS) of 1987 and Round One MBSS, with the greatest extent of acid-sensitive streams in Western Maryland and the Southern Coastal Plain. Seven PSUs, primarily in the same regions, had sites highly sensitive to acidification (ANC < 50 μeq/l). Also paralleling the Round One results, acidic deposition effects (33 sites in 8 PSUs) were more widespread than effects from acid mine drainage (0 sites) or agriculture (4 sites in 2 PSUs).

Although many water resource programs tend to focus on water chemistry-based definitions of stream quality, physical habitat degradation can have an equal or greater effect on stream ecosystems and their biological communities. A provisional Physical Habitat Index (PHI), developed using earlier MBSS data (Hall et al. 1999) was used to score sites sampled in 2002. PHI scores varied widely within and among PSUs. The mean PHI fell into the range of good in one PSU (Rocky Gorge Dam), while mean PHI was poor in one PSU (Back River) and fair in the remaining 17 PSUs. Stream mile estimates of the occurrence of poor to very poor PHI scores suggest that physical habitat degradation is widespread.

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During 2002, MBSS deployed continuous reading water temperature loggers at more than 200 sites between the months of June and August. The long-term goal is to use temperature data to (1) better characterize coldwater streams and (2) identify streams stressed by temperature changes, such as spikes from rapid inputs of warm water running off impervious surfaces during summer storms. Among all sites assessed, mean average daily water temperatures ranged from 12.8 to 24.8 °C, indicating the presence of both coldwater and warmwater sites in the data set. Future analyses of data from coldwater streams will assist in interpretation of IBI scores and will contribute to development of a fish IBI tailored to these systems, because trout and several non-game species require cool to cold waters. Six sites had more than 10% of their summer temperature readings above 32 °C.

In Maryland, concern for nutrient loadings to the Chesapeake Bay has drawn attention to the amounts of nitrogen and phosphorus transported throughout the watershed by streams. In MBSS 2002 sampling, total nitrogen tended to be highest on the Eastern Shore. In general, nitrate nitrogen made up the largest fraction of total nitrogen. Nitrate nitrogen concentrations greater than 1 mg/l are commonly considered to indicate anthropogenic influence; mean nitrate nitrogen concentrations exceeded this level in 15 of 19 PSUs. In several PSUs, nearly 100% of stream miles had high nitrate nitrogen concentrations. Total phosphorus tended to be substantially higher on the Eastern Shore, lower in Western Maryland, and moderate in the central part of the state.

Dissolved oxygen concentrations at most locations were greater than 5 mg/l, the COMAR standard and a level generally considered healthy for aquatic life. The only PSU with a mean DO < 5 mg/l was Potomac Lower Tidal/ Potomac Middle Tidal. Because sampling is done when the water is fairly clear, turbidity was generally low; a more complete characterization of turbidity would require sampling during storm events. Sulfate values were not generally high. Chloride tended to be highest in urban areas, especially Back River, and also at several sites near roadways that probably received substantial amounts of road salt. As expected, mean DOC and particulate carbon were highest in Coastal Plain basins, especially on the Eastern Shore.

Since the primary focus of the Round Two Survey is on smaller watersheds than in Round One, more attention has been paid to examining sampling results and potential stressors at individual sites. This report includes a snapshot of good and bad conditions that is illustrated by sites with the 10 best and 10 worst CBI scores. The report also includes a summary of results for each of the 19 PSUs sampled in the core (random) sampling for MBSS 2002. Each summary includes maps, land use statistics, and tables containing a variety of information on the sites sampled in each PSU. The benthic macroinvertebrate assessment results for the sites sampled by the volunteer Stream Waders program in 2002 are also indicated on each map. In addition, the Middle Patuxent River map includes site assessment results for sites sampled by Howard County, while the Rocky Gorge Dam and Potomac River Montgomery County map contain 5 site assessment results for sites sampled by Montgomery County. These examples illustrate the Survey's efforts to incorporate data from other sources to provide more intensive monitoring coverage of Maryland's watersheds. Additional data for each PSU are available on a Web-based searchable database at www.dnr.state.md.us/streams.

As each round of statewide sampling by the Survey is conducted at regular intervals over time, temporal changes (trends) in the stream condition statewide or for individual 8-digit watersheds can be evaluated. A comparison with data from Round One (1995-1997) was conducted where sample sizes were sufficient (i.e., in the three 8-digit watersheds sampled in 2002 that also had more than 10 samples in one or two years of MBSS Round One). Since yearly estimated 90% confidence intervals for fish or benthic IBI scores overlapped for all watersheds, no changes were apparent.

In 2000, the Survey initiated an annual monitoring effort at minimally disturbed sites (referred to as Sentinel sites) to help interpret the degree to which changes in biological indicator scores stem from natural variability. Sentinel sites are high quality sites most likely to remain undisturbed in the foreseeable future within four geographic regions of Maryland. In 2002, the original list of Sentinel sites was modified slightly and 24 sites were sampled. Although no more than four years of sampling is now available for any site, comparison of CBIs indicated that approximately 77% of all Sentinel sites varied less than 1.0. The results support that natural variability influences on biological indicating scores have been minimal since 2000.

Management Implications and Future Directions. The information being obtained by Round Two of the MBSS will continue to support a wide array of management decisions by Maryland DNR and other agencies. Major initiatives that have or will benefit from MBSS data include the new 2000 Chesapeake Bay Agreement, Maryland Land Conservation, Clean Water Action Plan, State water quality standards, Maryland biodiversity, and other local monitoring programs.

The MBSS results are expected to be highly useful for the new stream corridor commitments of the Chesapeake Bay Program. The Chesapeake 2000 Agreement (signed by Virginia, Maryland, Pennsylvania, District of Columbia, U.S. Environmental Protection Agency (EPA), and Chesapeake Bay Commission) newly recognizes "the need to focus on the individuality of each river, stream and creek" to meet the goal—"Preserve, protect and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Bay and its rivers." The stream corridor information provided by the Survey will also prove invaluable for other statewide programs. As part of the Chesapeake Bay-wide goal of restoring 2,010 miles of riparian buffers in the Chesapeake Bay watershed by the year 2010, Maryland is restoring 1200 miles of riparian vegetation along its stream corridors. MBSS data on the condition of constituent streams will help assign priorities for the purchase of GreenPrint and Rural Legacy lands.

The results of Round Two will continue to support Maryland's participation in the federal Clean Water Action Plan. Round One MBSS data were an essential component of the first Unified Watershed Assessment, helping designate both Category 1 (priorities for restoration) and Category 3 (priorities for protection) watersheds within Maryland. Restoration strategies have been developed for many of these priority watersheds, and 2000 sampling results will be used to help implement them (e.g., in Little Patuxent River watershed). Because the design of Round Two focuses on the finer geographic scale of Maryland 8-digit watersheds, future Unified Watershed Assessments will be more complete.

In addition to supporting these targeting initiatives, the identification of degraded stream segments has implications for comprehensive protection under the Clean Water Act, including use of MBSS 2002 (along with other data) to prepare the State's Clean Water Act 303(d) list and biennial 305(b) water quality report. In particular, the Maryland Department of the Environment has developed an interim framework for the application of biocriteria in the State's water quality standards and list of impaired waters (303(d) list). At present, the proposed biocriteria for wadeable, non-tidal (first- to fourth-order) streams rely on two biological indicators from the MBSS, the fish and benthic IBIs. The approach centers on identifying impaired waterbodies at the Maryland 8-digit watershed and 12-digit subwatershed levels. Ultimately these MBSS biological data may also contribute to refinement of the States' aquatic life use designations.

The information on biological diversity collected by the Survey exceeds that needed to designate the ecological condition of individual watersheds. The extensive geographic reach and quantitative sampling results of the Survey provide an unusual opportunity for evaluating the distribution and abundance of species previously designated as rare only by anecdotal evidence. For example, the endemic checkered sculpin and several other species have been collected in previously unreported locations. Based on the information gathered in Round One, Maryland DNR's Heritage and Biodiversity Programs recently proposed changes to state designations of rare, threatened, and endangered species.

One of the most promising trends related to the Survey has been the increase in interest and activity among Maryland county governments, non-governmental organizations, private businesses, and volunteers in stream monitoring. The success of the Survey has encouraged these groups to base their water resource management more directly on monitoring results. Many have instituted their own monitoring programs, often drawing upon or adopting MBSS sampling protocols. This report highlights the improved watershed coverage that can be obtained by incorporating volunteer Stream Waders data and the increased precision in stream assessments that can be attained by integrating MBSS data with that from local government monitoring programs such as Montgomery County. Maryland DNR expects to continue integration of the MBSS with those local government agencies that already have or are planning to initiate their own stream monitoring programs. The Maryland Water Monitoring Council (MWMC) will play an active role in encouraging collaborations between the state and local agencies.

As described above, the Round Two design provides significantly improved geographic resolution and additional stressor data, although more comprehensive understanding of watershed stressors will require data from other sources. Issues that require continued scrutiny in future years include the following:

- Extending the Survey into tidal streams
- Delineating more stream types requiring new indicators (e.g., coldwater and blackwater streams)
- Refining existing biological and physical habitat indicators
- Better characterization of existing and new stressors (e.g., estimating the contribution of eroded soil to sediment loading)
- Improving identification of rare species habitats and other biodiversity components
- Comparing among sample rounds for the detection of trends in stream conditions
- More coordination with counties for greater sample density or cost savings in areas of shared interest

In 2002, the Survey continued to make progress toward addressing these issues. Specifically, temperature loggers were deployed at nearly all randomly selected stream sites in 2000-2002 (and will continue to be deployed throughout Round Two) to improve our ability to identify coldwater streams. Analysis of existing coldwater and blackwater stream data was begun in hopes of developing separate reference conditions, and ultimately separate indicators, for these stream types.

Also in 2002, the Survey refined its existing physical habitat quality indicator (based on Round One data) by reanalyzing all existing physical habitat data. Independent of biological data, the Survey plans to apply this new PH1 to statewide MBSS Analysis of the conclusion of Round Two. Using targeted sampling of small streams in coordination with the U.S. Geological Survey, the MBSS developed a stream salamander Index of Biotic Integrity (SS-IBI) for potential use in streams without fish.

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1 INTRODUCTION

This report presents the results of the third year of the second round of sampling conducted by the Maryland Biological Stream Survey (MBSS or the Survey) to assess the Astate of the streams@ throughout Maryland. The year 2002 was the third of five years of sampling planned for Round Two. Sampling for the three-year Round One of the Survey was completed in 1997 and was summarized in Roth et al. (1999) and Boward et al. (1999). Results for each year of Round Two are reported annually and a summary report will be published when Round Two sampling is completed (for 2000 and 2001 results, see Roth et al. 2001b and Roth et al. 2003). This introductory chapter describes the history of the Survey, describes its components, and provides a roadmap to this year 2002 annual report.

1.1 HISTORY OF THE MBSS

In the 1980s, the Maryland Department of Natural Resources (DNR) recognized that atmospheric deposition was one of the most important environmental problems resulting from the generation of electric power. The link between acidification of surface waters and acidic deposition resulting from pollutant emissions was well established and many studies pointed to adverse biological effects of low pH and acid neutralizing capacity (ANC) and elevated levels of inorganic aluminum. To determine the extent of acidification of Maryland streams resulting from acidic deposition, DNR conducted the Maryland Synoptic Stream Chemistry Survey (MSSCS) in 1987. The MSSCS estimated the number of streams affected by or sensitive to acidification statewide, concluding that the greatest concentration of fish resources at risk may be in streams throughout the Appalachian Plateau and Southern Coastal Plain physiographic provinces (Knapp et al. 1988).

While the MSSCS demonstrated the potential for adverse effects on biota from acidification, little direct information was available from the field on the biological responses of Maryland streams to water chemistry conditions. For this reason, in 1993, DNR created the MBSS to provide comprehensive information on the status of biological resources in Maryland streams and how they are affected by acidic deposition and other cumulative effects of anthropogenic stresses. The MBSS is now nine years old and continues to help environmental decision-makers protect and restore the natural resources of Maryland. The primary objectives of the MBSS are to

- assess the current status of biological resources in Maryland's non-tidal streams;
- quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- provide a statewide inventory of stream biota;
- establish a benchmark for long-term monitoring of trends in these biological resources; and
- target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

To meet these and other objectives of the MBSS, a list of 64 questions that the Survey will try to answer was developed. These questions fall into three categories: (1) characterizing biological resources, physical habitat, and water quality (such as the number of fish in a watershed or the number of stream miles with pH < 5); (2) assessing the condition of these resources (as deviation from minimally impaired expectations); and (3) identifying likely sources of degradation (by delineating relationships between biological conditions and anthropogenic stresses).

Answering these questions has required a progression of steps in the implementation of the Survey, including (1) devising a sampling design to monitor wadeable, non-tidal streams throughout the state and allow area-wide estimates of the extent of the biological resources, (2) implementing sampling protocols and quality assurance/quality control procedures to assure data quality and precision, (3) developing indicators of biological condition so that degradation can be evaluated as a deviation from reference expectations, and (4) using a variety of analytical methods to evaluate the relative contributions of different anthropogenic stresses.

In creating the Survey, DNR implemented a probability-based sampling design as a cost-effective way to characterize statewide stream resources. By randomly selecting sites, the Survey can make quantitative inferences about the characteristics of the more than 10,000 miles of non-tidal streams in Maryland. The EPA is encouraging the use of random sampling designs to assess status and trends in surface water quality (EPA 1993). The Round One MBSS design began with the MSSCS sample frame and was modified during the 1993 pilot and 1994 demonstration phases to provide answers to the questions of greatest interest (Vølstad et al. 1995, 1996). That design allowed robust estimates at the level of stream size (Strahler orders 1, 2, and 3), large watershed (17 river basins), and the entire state. Estimates by other categories, such as counties or smaller watersheds (138 in Maryland), were possible depending on the number of sample points in each unit. Round Two of the MBSS has a slightly different design that allows estimates at the level of smaller watersheds (85 individual or combined Maryland 8-digit watersheds); to achieve the necessary sample density at the available level of effort, Round Two will take five years to complete (rather than the three years in Round One).

DNR recognized that the utility of these estimates depended on accurately measuring appropriate attributes of streams. The Survey focuses on biology for two reasons: (1) organisms themselves have direct societal value and (2) biological communities integrate stresses over time and are a valuable and cost-effective means of assessing ecological integrity (i.e., the capacity of a resource to sustain its inherent potential). Inevitably, overall environmental degradation is tied to a failure of the system to support biological processes at a desired level (Karr 1993). It is equally important to recognize that the natural variability in biota requires that several components of the biological system be monitored. Fish are an important component of stream integrity and one that also contributes substantial recreational values. The Survey collects quantitative data for the calculation of population estimates for individual fish species (both game and nongame). These data can also be used to evaluate fish community composition, individual fish health, and the geographic distribution of commercially important, rare, or non-indigenous fish species. Benthic (bottom-dwelling) macroinvertebrates are another essential component of streams and they constitute the second principal focus of the Survey. The Survey uses rapid bioassessment procedures for collecting benthic macroinvertebrates; these semi-quantitative methods permit comparisons of relative abundance and community composition, and have proven to be an effective way of assessing biological integrity in streams (Hilsenhoff 1987, Lenat 1988, Plafkin et al. 1989, Kerans and Karr 1994, Resh 1995, Barbour et al. 1999). The Survey also records the presence of amphibians and reptiles (herpetofauna), freshwater mussels, and aquatic plants (both submerged aquatic vegetation (SAV) and emergent macrophytes). The Survey has established rigorous protocols (Kazyak 2001) for each of these sampling components, as well as training and auditing procedures to assure that data quality objectives are met.

Although the MBSS sampling design and protocols provide exceptional information for characterizing the stream resources in Maryland, designation of degraded areas and identification of likely stresses requires additional activities. Assessing the condition of biological resources (whether they are degraded or undegraded) requires the development of ecological indicators that permit the comparison of sampled segment results to minimally impacted reference conditions (i.e., the biological community expected in watersheds with little or no human-induced impacts). The Survey has used its growing database of information collected with consistent methods and broad coverage across the state to develop and test indicators of individual biological components (i.e., fish and benthic macroinvertebrates) and a provisional indicator of physical habitat quality (Roth et al. 2000, Stribling et al. 1998, Hall et al. 1999). These three indices are the basis for estimating the number of stream miles in varying degrees of degradation (good, fair, poor, and very poor condition) and mapping the locations of sites by their condition. Each of these indicators consists of multiple metrics using the general approach developed for the Index of Biotic Integrity (IBI) (Karr et al. 1986, Karr 1991) and the Chesapeake Bay Benthic Restoration Goals (Ranasinghe et al. 1994). The fish and benthic IBIs (which combine attributes of both the number and the type of species found) are widely accepted indicators that have been adapted for use in a variety of geographic locations (Miller et al. 1988, Cairns and Pratt 1993, Simon 1999). The Survey currently reports a composite fish and benthic indicator (Combined Biotic Index, or CBI) and is investigating the possibility of developing additional indicators (e.g., salamanders in small streams with few or no fish).

In addition to using reference-based indicators, the Survey applies a variety of analytical methods to the question of which stresses are most closely associated with degraded streams. This involves correlational and multivariate analyses of water chemistry, physical habitat, land use, and biological information (e.g., presence of non-native species). The biological information also provides an unusual opportunity for evaluating the status of biodiversity across the state; the distribution and abundance of species previously designated as rare only by anecdotal evidence can be determined and unique combinations of species at the ecosystem and landscape levels can be identified. Land use and other landscape-scale metrics also play an important role in identifying the relative contributions of different stresses to the cumulative impact on stream resources. Ultimately, the Survey seeks to provide an integrated assessment of the problems facing Maryland streams that will facilitate interdisciplinary solutions.

The research progress and assessment results of Round One of the MBSS are reported in Roth et al. (1999) and Boward et al. (1999). Among other findings, Round One collected 83 fish species, including a number of rare species. According to the fish IBI, 45% of stream miles fell into the range of good to fair, while 49% fell into this range according to the benthic IBI. Similarly, 49% of stream miles were rated good to fair by the physical habitat index. Statewide, 28% of stream miles were acidic or acid sensitive, indicating a slight improvement since the 1987 MSSCS. Acidic deposition was by far the most common source of stream acidification, dominating 19% of stream miles. Statewide, 59% of stream miles had nitrate-nitrogen concentration greater than 1.0 mg/l, indicating anthropogenic sources. Nearly all sites with greater than 50% urban land use had IBI scores indicative of poor to very poor biological condition. These and other results are already being used by Maryland DNR to target resource management efforts and to reevaluate state designations of rare, threatened, and endangered species. MBSS Round One Results have also been used to support Maryland=s Unified Watershed Assessment and other components of the Federal Clean Water Action Plan, the Maryland Tributary Strategy Teams= plans to reduce nutrient contributions to the Chesapeake Bay, and the Maryland Department of the Environment=s water quality standards program that lists impaired waters and develops total maximum daily loads (TMDLs). Round Two of the Survey will continue to contribute to these activities and, by refining the assessment of watershed conditions, may provide even greater utility to managers.

1.2 ROUND TWO OF THE MBSS

2000 was the first year of sampling for Round Two of the Survey. Results from 2000 can be found in Roth et al. (2001b). Round Two is a natural extension of the MBSS as it began in 1993 and it includes both (1) a core survey based on statewide sampling of random stream segments and (2) ancillary targeted sampling dedicated to additional monitoring and special studies. The core survey produces the majority of MBSS results and is the focus of this report. The information gathered by the ancillary sampling is included where convenient for completeness, but extensive data analysis of these additional results is reserved for separate reports (but see Chapter 6 on Sentinel Site sampling).

To meet the state=s growing need for information at finer spatial scales, Round Two=s core survey was redesigned to focus on Maryland=s 8-digit watersheds (Table 1-1). The Round Two design was also based on a new 1:100,000-scale base map; this means that more small streams will be sampled than were sampled in Round One. Specifically, Round Two=s design allows estimates at the level of 85 individual or combined Maryland 8-digit watersheds by ensuring that each watershed has 10 or more sample sites. To achieve this sample density at the same annual level of effort, Round Two will take five years to complete (rather than the three years in Round One), running from 2000 through 2004. The details of the Round Two study design are presented Section 2.2 of this report.

The results of Round Two=s core survey will be presented in much the same way as for Round One. Unusual or rare or important species will be included to highlight our improving understanding of the state=s biodiversity. The status of sampled watersheds and individual stream segments will be reported, focusing on the conditions ratings of the fish and benthic IBI. Stressor results (for acidification, physical habitat, and nutrients) will be reported within and among watersheds. The 2002 report will also present preliminary comparisons with the Round One data and begin to discuss trends in the condition of Maryland=s streams. Individual sites= results for each watershed will be included, with additional information available on a Web-based searchable database at www.dnr.state.md.us/streams. The sampling frame for Round Two is based on a 1:100,000 scale map, and includes a substantial number of streams (primarily first-order) that were not included in the sampling frame used for Round One (1:250,000 map). In the estimation of differences in statewide stream condition between the two rounds, the bias resulting from differences in sampling frames can be corrected for by limiting the analysis to the population of streams that overlaps for the two sampling frames. The difference in map scale is likely to have only a small effect on parameters such as the mean IBI scores because the IBI scoring method is calibrated to adjust for effects of stream size on the expected number of species and other metrics. Results in Vølstad et al. (2001) suggest the mean fish IBI scores for an 8-digit watershed in Montgomery County (Seneca Creek) based on the County survey (1:24,000 map scale) is similar to the mean score based on the MBSS (1:100,000 scale).

Table 1-1. Relative sizes of United States Geological Survey (USGS) and Maryland hydrologic units			
	USGS 8-digit Cataloging Unit (MD 6-digit Basin)	**MD 8-digit Watershed**	**MD 12-digit Subwatershed**
Number in Maryland	20	138	1066
Average size in Maryland (approx.)	500 sq. mi.	75 sq. mi.	8 sq. mi.

While the data obtained from Round Two can still be aggregated to characterize basin or statewide conditions, the new design was intended primarily to provide estimates of stream condition at the smaller watershed level needed by many of the State=s watershed assessment and management programs and by local governments. For example, both the State=s Unified Watershed Assessment / Clean Water Action Plan and its interim biological criteria framework for non-tidal streams (MDE 2000) employ data to assess and rank Maryland 8-digit watersheds. The interim biocriteria framework for Maryland incorporates stream ratings based on fish and benthic IBIs developed by the MBSS (Roth et al. 2000, Stribling et al. 1998) to identify 8-digit watersheds and 12-digit subwatersheds that are impaired. Results from MBSS 2000 will be used to prepare the State=s Clean Water Act 303(d) list and 305(b) water quality report.

Although the Survey will provide the data needed to characterize the status of all 8-digit watersheds (averaging 75 mi^2 in area), it will not have sufficient sampling density to characterize most of the 1066 smaller 12-digit subwatersheds (averaging 8 mi^2 in area). Therefore, Round Two of the MBSS has been expanded by DNR to include a new volunteer effort (Maryland Stream Waders) and closer coordination with County stream monitoring programs. Maryland DNR is evaluating the feasibility of integrating data from these other monitoring programs by studying the comparability of each program=s sampling and analytical methods. By incorporating these data, the MBSS hopes to characterize many areas of the state at this finer spatial scale.

In 2000, Maryland DNR launched its volunteer-based Maryland Stream Waders initiative, a benthic sampling program. Each volunteer was trained by Maryland DNR staff in methods documented in the Maryland Stream Waders stream sampling manual (Boward 2001) and quality was assured through 5% duplicate sampling, taxonomic confirmations, and laboratory subsampling. In 2002, volunteers sampled 298 sites within twelve of the nineteen watersheds sampled by MBSS crews. A benthic family-level IBI was calculated for these sites (Stribling et al. 1998). Stream Wader results are presented in Chapter 4 of this report. For further information on Stream Waders, see http://www.dnr.state.md.us/streams/mbss/mbss_volun. html. The goals of the program are to:

- increase the density of sampling sites for use in stream quality assessments;
- improve stream stewardship ethics and encourage local action to improve watershed management;
- educate local communities about the relationship between land use and stream quality; and
- provide quality-assured information on stream quality to state, local, and federal agencies, environmental organizations, and others.

At the same time, Maryland DNR is working with several County (and Baltimore City) stream monitoring programs to coordinate monitoring and assessment efforts. Issues of study design, site selection, comparability of field and laboratory protocols, quality control, and integrated analysis are being addressed as cooperative efforts with the counties. For example, the MBSS and Montgomery County Department of Environmental Protection recently completed a EPA-sponsored case study that outlines general guidelines for integrating state and county programs (Roth et al. 2001a). Currently, the MBSS is also working with the Prince George=s County, Howard County, and Baltimore County/City programs. Where feasible, the more spatially intensive monitoring results from the counties will be incorporated into MBSS reporting. Both state and county stream monitoring programs may also realize cost savings by sharing sampling results.

In addition to improving the spatial intensity of sampling, Round Two will address temporal variability by regular monitoring of fixed Asentinel@ sites. In 2000, DNR established a network of sentinel sites deemed to be minimally impacted by human activities. A total of 25 sentinel sites were selected in areas where land uses were unlikely to change over time (e.g., state parklands) from a pool of least-impacted reference sites identified in Round One (i.e., sites meeting designated water chemistry, physica habitat, and land use criteria). In 2002, 24 potential sentinel sites were sampled. Chapter 6 of this report describes sampling efforts at the Sentinel sites in 2002.

In addition, three sites were sampled in the Liberty Reservoir watershed during 2002 at the request of Carroll County government.

1.3 ROADMAP TO THIS REPORT

This report presents the results of the 2002 annual sampling of Round Two of the MBSS and includes 8 chapters and 4 appendices. Chapter 2 provides a general description of the overall sampling design used in Round Two and describes Stream Wader results are presented in Chapter 4 of this report. For further information on Stream Waders, see the specific survey methods used. Chapter 2 also includes a brief description of the field and laboratory protocols and the statistical methods used in data analysis. Chapter 3 provides a comparative assessment of the watersheds sampled in 2002. Separate sections in Chapter 3 focus on biodiversity, biological indicator results, and three predominant issues affecting biological resources: acidification, physical habitat, and nutrients. Chapter 4 summarizes the sampling results for individual watersheds with tabular and map data. Chapter 5 compares the results of the 2002 sampling with Round One (1995-1997) of the Survey. Chapter 6 provides the results of sampling at MBSS sentinel sites. The conclusions of this report are presented in Chapter 7, focusing on management implications, dominant stressors, and emerging trends. References are in Chapter 8, while summary data tables and weather information are in the Appendices.

2 METHODS

2.1 BACKGROUND

This chapter presents the study design and procedures used to implement Round Two of the Maryland Biological Stream Survey (MBSS or the Survey). Details of the study design and sample frame are included below, along with a summary of landowner permission results and the number of sites sampled in watersheds selected for sampling in 2002. This background material is followed by a summary of field and laboratory methods for each component: water chemistry, benthic macroinvertebrates, fish, amphibians and reptiles, vegetation, and physical habitat. Quality assurance (QA) activities are also described. For further details on Round Two methods, see the MBSS Sampling Manual (Kazyak 2001).

For the most part, methods used in Round Two of the MBSS (2000-2004) are identical to those of Round One (1995-1997). However, some changes were made to improve the quality and/or usefulness of the data generated. These changes in sampling methods include (1) modifications to the physical habitat assessment and characterization, (2) the addition of new chemical analytes (total nitrogen, nitrite, ammonia, orthophosphate, total phosphorous, chloride, and turbidity), (3) collection of continuous in-stream temperature readings at all randomly-selected sample sites throughout the summer, and (4) characterization of invasive terrestrial plant abundance. In addition, the reach file used to select sites is the 1:100,000-scale map developed by USGS; this is a change from the 1:250,000-scale map used in Round One. Another change to the sample frame is the expansion of the Survey to include fourth-order, non-tidal streams.

2.2 STATISTICAL METHODS

2.2.1 Survey Design

The second round of the MBSS is being conducted over five years and started in the year 2000. The Round Two Survey was designed to provide an assessment of stream condition in each of the Maryland 8-digit watersheds that contain non-tidal streams. It also facilitates the assessment of average stream condition over the five-year period for (1) the entire state, (2) the 17 major (Maryland 6-digit) drainage basins, and (3) other areas of interest such as counties and regions. The design was subject to the following level-of-effort constraints: (1) that a maximum of 300 sites be sampled per year, with approximately 210 allocated to the core random design, and (2) that the maximum sampling interval be 5 years.

2.2.2 Sample Frame

The sample frame for the 2000-2004 MBSS is based on the 1:100,000-scale stream network, a map scale consistent with that used by EPA and other states. The frame was constructed by overlaying the 138 Maryland 8-digit watershed boundaries (Figure 2-1) on a map of all stream reaches in the study area as digitized on a U.S. Geological Survey 1:100,000-scale map. It includes all non-tidal stream reaches of fourth-order and smaller, excluding impoundments that are non-wadeable or that substantially alter the riverine nature of the reach (see Kazyak 1994). Fourth-order streams were included to expand statewide coverage and ensure that all the streams classified as third-order by the 1:250,000 map (and sampled in the 1995-1997 MBSS) were also covered in the 2000-2004 MBSS. Four 8-digit watersheds (Atlantic Ocean, plus the Upper, Middle, and Lower Chesapeake Bay) were excluded from the sample frame because they describe marine/estuarine waters and do not contain non-tidal streams. Of the 134 watersheds included in the frame, 79 contained less than 100 non-tidal stream miles each; these were combined into 29 "super-watersheds" with between 2 and 7 constituent 8-digit watersheds each. When combined with the 55 remaining "stand alone" watersheds, a total of 84 watersheds of concern were identified as discrete sampling units for Round Two (Table 2-1).

The Strahler convention (Strahler 1957) was used for identifying stream reaches in each 8-digit watershed by order. First order reaches, for example, are the most upstream reaches in the branching stream system. The designation of stream order for a particular reach depends on the scale and accuracy of the map.

2.2.3 Sample Selection

The second round of MBSS was restricted to a maximum of 300 sampling sites per year (210 within the core survey). Hence, it was not practical to stratify the network of streams in Maryland by 8-digit watersheds and sample them annually (i.e., only 2 sites could be sampled in each of the 134 watersheds each year under that design, resulting in unreliable estimates at the 8-digfit watershed scale). In addition, the costs of traveling to sample each year under that design, resulting in unreliable estimates at the 8-digit watershed scale). In addition, the costs of traveling to sample each watershed each year would be high, resulting in fewer than 210 sites being sampled annually. As an alternative to stratifying by watershed, the Survey designated the 84 watershed units of concern (both 55 single watershed units and 29 super-watersheds) as primary sampling units (PSUs). A subset of the 84 PSUs will be selected randomly each year, with

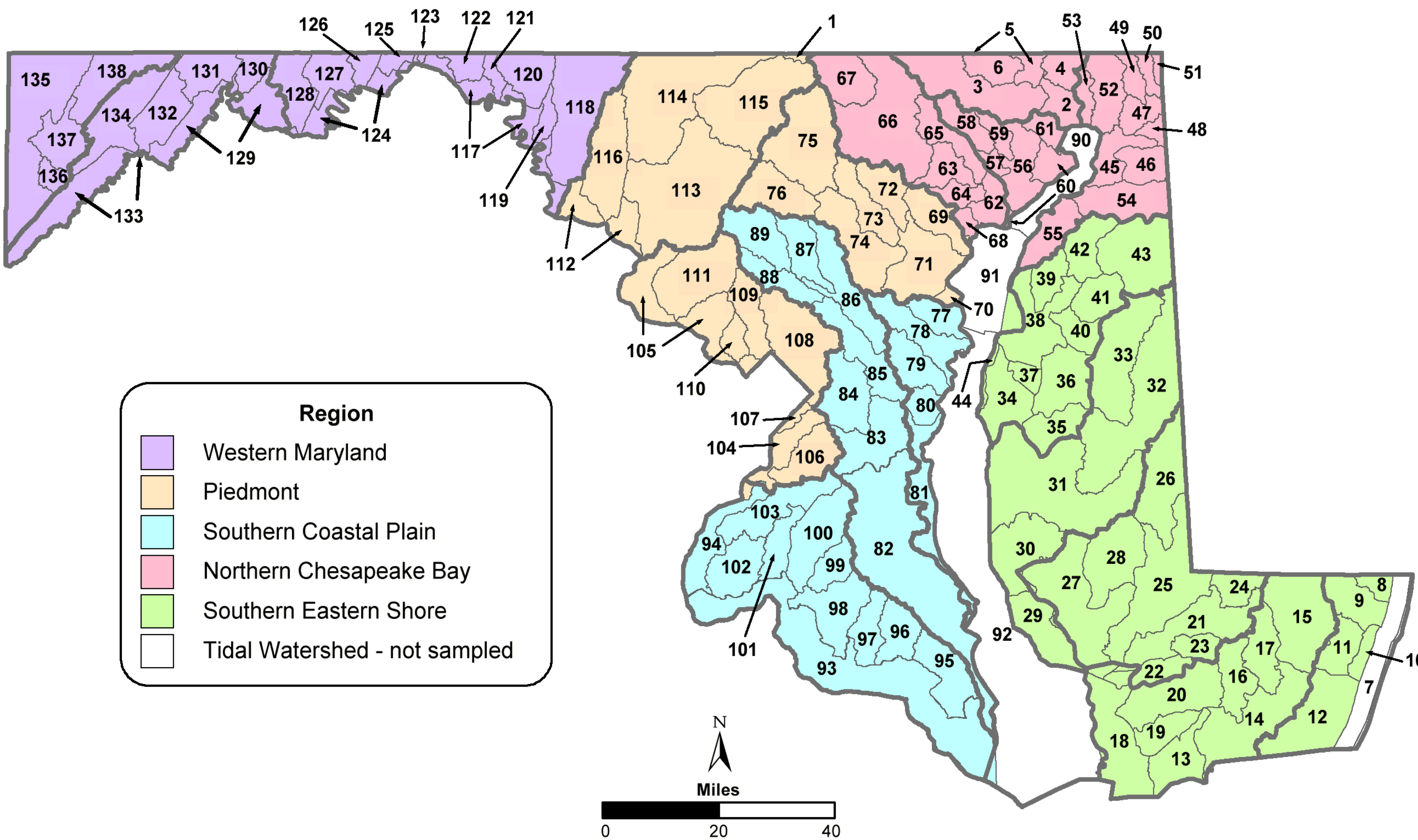

Region
Western Maryland
Piedmont
Southern Coastal Plain
Northern Chesapeake Bay
Southern Eastern Shore
Tidal Watershed - not sampled
N
Miles
0
20
40

Table 2-1. Maryland individual and combined watersheds (primary sampling units or PSUs) to be sampled in the 2000-2004 MBSS. * indicates watershed selected that year for repeated sampling

Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Youghiogheny	Youghiogheny River	135		X				6
	Little Youghiogheny/Deep Creek Lake	136/137					X	
	Casselman River	138	X					
North Branch Potomac	Potomac River Lower North Branch	129				X		5
	Evitts Creek	130					X	
	Wills Creek	131					X	
	Georges Creek	132				X		
	Potomac River Upper North Branch	133		X				
	Savage River	134			X			4
Upper Potomac	Antietam Creek	118				X		4
	Potomac WA Co/Marsh Run/Tonoloway/Little Tonoloway	117/119/123/125	X		*			3
	Conococheague	120			X			
	Little Conococheague/Licking Creek	121/122					X	
	Potomac AL Co/Sideling Hill Creek	124/126		X				
	Fifteen Mile Creek	127	X					
	Town Creek	128	*		X			
Middle Potomac	Potomac River FR Co	112					X	
	Lower Monocacy River	113				X		11
	Upper Monocacy River	114	X					8
	Conewago Creek/Double Pipe Creek	1/115			X			7
	Catoctin Creek	116				X		4
Potomac Wash Metro	Potomac River MO Co	105			X			5
	Piscataway Creek	106		X				
	Potomac Upper Tidal/Oxon Creek	104/107		X				
	Anacostia River	108					X	5
	Rock Creek/Cabin John Creek	109/110				X		
	Seneca Creek	111		X				5
Patapsco	Back River	69			X			
	Bodkin Creek/Baltimore Harbor	70/71		X			*	
	Jones Falls	72			X			
	Gwynns Falls	73					X	
	Patapsco River Lower North Branch	74	X					4
	Liberty Reservoir	75	X			*		5
	South Branch Patapsco	76	X					

Table 2-1. (Continued)

Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Patuxent	Little Patuxent River	86	X					3
	Middle Patuxent River	87			X			
	Rocky Gorge Dam	88			X			
	Brighton Dam	89	X					
	Patuxent River Lower	82					X	8
	Patuxent River Middle	83		X				3
	Western Branch	84		X				
	Patuxent River Upper	85					X	
Lower Potomac	Breton/St. Clements Bays	96/97			X			
	Potomac Lower Tidal/Potomac Middle Tidal	93/94			*		X	
	St. Mary's River	95	*			X		
	Wicomico River	98					X	
	Gilbert Swamp	99		X				
	Zekiah Swamp	100		X				3
	Port Tobacco River	101				X		
	Nanjemoy Creek	102	X					
	Mattawoman Creek	103	X					
West Chesapeake	Magothy River/Severn River	77/78				X		
	South River/West River	79/80			X			
	West Chesapeake Bay	81				X		
Gunpowder	Gunpowder River/Lower Gunpowder Falls/Bird River/ Middle River-Browns	62/63/64/68			X			
	Little Gunpowder Falls	65		*		X		
	Loch Raven Reservoir	66			X			7
	Prettyboy Reservoir	67	X					
Susquehanna	Lower Susquehanna/Octoraro Creek/Conowingo Dam Susquehanna	2/4/5					X	
	Deer Creek	3		X			*	4
	Broad Creek	6				X		
Bush	Aberdeen Proving Ground/Swan Creek	60/61	X					
	Lower Winters Run/Atkisson Reservoir	57/58					X	
	Bush River/Bynum Run	56/59					X	
Elk	Northeast River/Furnace Bay	52/53		X				
	Lower Elk River/Bohemia River/Upper Elk River/Back Creek/Little Elk Creek/Big Elk Creek/Christina River	45/46/47/48/49/50/51				X		
	Sassafras River/Stillpond-Fairlee	54/55		X				

Table 2-1. (Continued)

Basin	Watershed	Watershed Number	2000	2001	2002	2003	2004	Extra Sites
Chester	Eastern Bay/Kent Narrows/Lower Chester River/ Langford Creek/Kent Island Bay	34/37/38/39/44			X			
	Miles River/Wye River	35/36				X		
	Corsica River/Southeast Creek	40/41	X					
	Middle Chester River	42			X	*		
	Upper Chester River	43					X	
Choptank	Honga River/Little Choptank/Lower Choptank	29/30/31				X		
	Upper Choptank	32	X					
	Tuckahoe Creek	33				X		
Nanticoke/Wicomico	Lower Wicomico/Monie Bay/Wicomico Creek/Wicomico River Head	21/22/23/24	X					
	Nanticoke River	25		*	X			
	Marshyhope Creek	26					X	
	Fishing Bay/Transquaking River	27/28					X	
Pocomoke	Pocomoke Sound/Tangier Sound/Big Annemessex/Manokin River	13/18/19/20				X		
	Lower Pocomoke River	14			X			
	Upper Pocomoke River	15		X				3
	Dividing Creek/Nassawango Creek	16/17		X				
Ocean Coastal	Assawoman/Isle of Wight/Sinepuxent/Newport/Chincoteague Bays	8/9/10/11/12		X				
Other	Upper Chesapeake Bay/Middle Chesapeake Bay/Lower Chesapeake Bay/Atlantic Ocean	90/91/92/7						
Total			18	19	19	19	19	107

restrictions to ensure that all 8-digit watersheds are sampled once during the five-year sampling period. Using this approach, a representative sub-set of watersheds can be studied each year, covering all the 84 watersheds of concern over a five-year period.

2.2.3.1 Lattice Sampling of Watersheds (PSUs)

Lattice sampling was used to schedule the sampling of all 84 watersheds (PSUs) over a 5-year period (see Cochran 1977; Jessen 1978). A sampling frame for selecting watersheds across time was formed by arranging the PSUs into a lattice with 84 rows and one column for each year (Table 2-1).

The 84 PSUs were stratified into five physiographic regions (strata) to ensure that their sampling is spread out geographically during each sample year (Figure 2-2). These five regions include whole major (Maryland 6-digit) drainage basins and divide the State into approximately equal parts. This stratification by region was done to spread out the sampling in space and thereby increase precision in statewide estimates; the geographic strata are not considered important reporting units.

A first-stage random sample of PSUs is drawn from each region in each year, with restrictions to ensure that all 84 watersheds (PSUs) of concern are sampled at least once during the 5-year sampling period. The lattice sampling supports an estimate of average statewide condition over the 5-year period. This strategy is similar to the lattice design used in the 1994 Demonstration Study (Vølstad et. al 1996) and the 1995-1997 MBSS Round One design (Roth et al. 1999); it takes into account the restrictions in annual sampling effort. About one-fifth of the watersheds in each of the five regions are randomly selected (without replacement) each year. In addition, two randomly selected watersheds in each region are being sampled twice during the five-year Survey (in randomly selected years). The representative sampling over time, augmented by repeated sampling of watersheds, ensures that all PSUs and pairs of PSU combinations have a known probability (greater than zero) of being selected. This probability-based sampling facilitates the estimation of statewide average condition over the 5-year study period with quantifiable precision based on the Horvitz-Thompson estimator (Horvitz and Thompson 1952; Thompson 1992). It also allows estimation of statewide conditions for each year of the Survey.

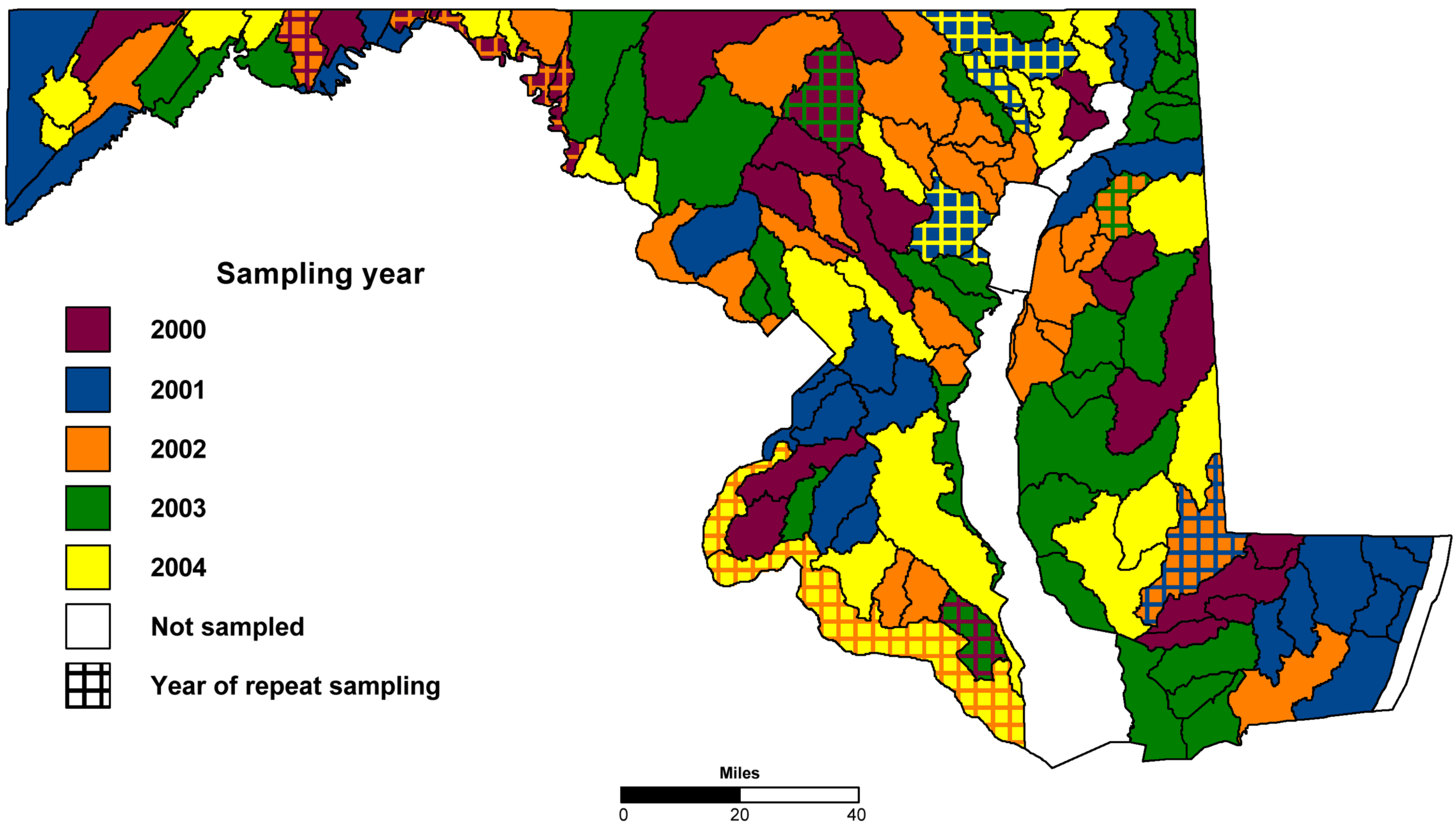
2.2.3.2 Stratified Random Sampling within PSUs

Within each PSU, the elementary sampling units from which field data are collected (i.e., the 75-m stream segments or sites) are selected using either stratified random sampling with proportional allocation, or simple random sampling (Cochran 1977). This allocation ensures that all sites in a PSU stream network have the same probability of being selected. The target sample size in each PSU is a minimum of 10 sites for the spring benthic sampling. Because of imperfections in the sample frame, a list of random replacement sites is provided for each PSU.

When the Round Two design was proposed, the target minimum of 10 sites per PSU was determined by analyzing the expected variability in IBI mean scores and percentage stream mile estimates as a function of varying sample size. Analysis (as presented in Southerland et al. 2000) indicated that fewer than 10 sites per PSU would not yield sufficient precision in stream mile estimates. Working with DNR, the survey designers determined that 10 sites per watershed would yield an acceptable level of precision while remaining within other design constraints (i.e., the annual level of effort available for sampling and the maximum sampling interval of five years for the statewide survey).

When feasible, the streams in each of the 55 PSUs consisting of a single 8-digit watershed were grouped into two strata based on stream order. One stratum includes all the first- and second-order streams, while the other includes all the third- and fourth-order streams. The number of sites in each of the two strata are allocated proportional to their stream length, resulting in equal sampling density for the two strata. In watersheds where the proportion of stream miles in one stratum (e.g., third- and fourth-order streams) is significantly below 10%, the stringent proportional allocation could not be achieved because it would result in allocation of less than one sample site to this stratum. Samples were not forced into strata that contained a minimal portion of stream miles, because this would eliminate the simplicity of equal probability sampling. Instead, the strata for such PSUs were collapsed, and a simple random sample of sites from all streams was selected.

A different stratification was used for the 29 PSUs consisting of more than one 8-digit watershed (i.e., the super-watersheds). For these PSUs, each constituent 8-digit watershed was designated a stratum, and the strata receive equal sampling fractions (i.e., proportional to stream miles in each 8-digit watershed). This stratification of super-watersheds was done to ensure that the non-tidal streams in each individual 8-digit watershed were sampled. While this approach may increase precision of stratified estimates for the super-watershed, the precision in estimates for individual 8-digit watersheds will generally be low because of low sample sizes. The limited sample sizes allocated to each PSU did not allow further stratification of the super-watersheds by stream order.


Sampling year
2000
2001
2002
2003
2004
Not sampled
Year of repeat sampling
Miles
0
20
40

When one or more of the initial sample of stream segments in a PSU could not be sampled (e.g., dry stream or no permission to access), the stratification of the PSU was abandoned, and the replacement sites were selected from a list of simple random sites. This adjustment was made because the fraction of unsampleable sites cannot be adequately quantified for individual strata with low sample sizes.

2.2.3.3 Allocation of Additional Sites to Large Watersheds

Additional sites were allocated to 22 watersheds with more than 100 non-tidal stream miles. Increased sample sizes in these watersheds will reduce the variance of key estimates and improve statewide estimates (by more closely approximating statewide allocation proportional to stream miles). Over the five-year Survey, a total of 106 additional sites were allocated proportional to stream miles within these large watersheds (Table 2-2).

Table 2-2. List of MBSS Round Two Primary Sampling Units with greater than 100 non-tidal stream miles, scheduled for additional sample sites

Primary Sampling Unit	Number of Stream Miles	Number of Additional Sites
Lower Monocacy River	388.39	11
Upper Monocacy River	284.38	8
Patuxent River Lower	280.90	8
Loch Raven Reservoir	237.10	7
Conewago Creek/Double Pipe Creek	231.16	7
Youghiogheny River	222.56	6
Liberty Reservoir	184.08	5
Seneca Creek	178.85	5
Potomac River Lower North Branch	165.45	5
Potomac River MO Co	160.68	5
Anacostia River	159.34	5
Antietam Creek	146.34	4
Deer Creek	142.62	4
Patapsco River Lower North Branch	129.50	4
Catoctin Creek	128.95	4
Savage River	127.13	4
Upper Choptank	127.02	4
Little Patuxent River	122.48	3
Zekiah Swamp	120.75	3
Potomac WA Co/Marsh Run/Tonoloway/Little Tonoloway	118.43	3
Patuxent River Middle	111.19	3
Upper Pocomoke River	109.65	3

2.2.4 Site Selection

- Sample Frame Construction. The stream order of each reach was attributed on the 1:100,000-scale USGS Digital Line Graph (DLG) maps. If necessary, 1:24,000-scale USGS topographic maps were used as references to identify flow patterns or to see more detail. Where necessary, maps from Pennsylvania and Delaware were used to identify the stream order of water bodies originating outside of Maryland.

- Random Site Picks. Once the sample frame was developed for a PSU, sites were randomly assigned according to the stratified design described above using a FORTRAN-based program. If the proportion of stream miles in the smallest strata (either stream-order-based in single watershed PSUs or watershed-based in the super-watersheds) was greater than or equal to 10%, sites were allocated proportionally among strata; if it was less than 10%, the strata were collapsed and sites allocated by simple random sampling. After the target number of sites was selected (10 to 21 sites depending on PSU size), a simple random selection of "extra sites" to a total of 50 was chosen in each PSU using the GIS. This was done to ensure that a sufficient number of sites remained available for sampling after permission denials and unsampleable sites were removed from consideration.

Each sample point chosen on the GIS was designated as the midpoint of the 75-m sampling segment in the field. Sites selected less than 75 meters from another randomly-selected site (both upstream and downstream) were eliminated. Sites that could possibly cross stream network nodes were not eliminated from the program; it was assumed that these sites could be adjusted in the field by moving the starting point away from the node, but staying within the designated stream order.

Each site was then attributed with the following information:

- stream order
- county
- basin
- physiographic region
- northing, easting
- latitude and longitude (both in decimal degrees and in degrees, minutes, seconds)
- watershed name and MD 8-digit watershed code.

2.2.5 Permissions from Landowners

- Extra Permissions. Permission was solicited to sample from landowners at twice the number of sites allocated to each PSU by the design (usually 20 sites, but from 26 to 42 in the larger watersheds). While the allocated number of sites (usually 10) were selected from the appropriate strata (see above), the "extra sites" were chosen to fill out the list, regardless of stream order. At the completion of site selection for each county, sites were sent to DNR for generation of 1:24,000-scale topographic maps and commun-ication of sites to local governments planning stream monitoring.

- Landowner Identification. Each site was plotted on county tax maps using the Maryland Office of Planning Maryland Property View System obtained from DNR. From this, property owners could be identified, both for the site containing the sampling site and for any areas required to access the stream. Phone numbers were obtained from the internet using a white pages directory (http://www.switchboard. com).

- Landowner Contact. If the phone number was unlisted, a letter was prepared requesting permission to access the property, including a written form and telephone contact information through which the landowner could respond. The letter also provided a MBSS brochure and telephone number to call for more information. If the number was listed, the property owner was called and permission to access the site was requested. After 2-3 calls and no success, a letter was sent. If the owner gave permission, the caller requested additional information about the site, such as whether the stream was often dry or hard to access. The caller also recorded whether the crew needed to make a pre-visit call to the landowner or whether the owner had to be available to open gates or walk the crew through the property. All property owner information was entered and maintained in a Microsoft Access database.

- Field Crew Information. Permission packets were then prepared for the field crews. Packets contained a printout of the property owner information for each site and a tax map showing possible access routes. The callers attempted to obtain permissions for the target sites in the proportions that stream orders occur in each PSU. In addition, permissions were obtained for extra sites (up to 50% more than the targeted number) to account for non-sampleable sites. These extra sites represent a simple random sample and may or may not be of the same stream order as the originally selected sites (for example, if a third- to fourth-order site was unsampleable, the replacement site was the next on the simple random list, regardless of stream order

2.3 ANALYTICAL METHODS

2.3.1 Estimation of Means, Proportions and Totals Within Watersheds (PSUs)

2.3.1.1 Standard Estimators for the MBSS Sampling Program

The MBSS sampling design within watersheds (PSUs) involves simple random sampling, or stratified random sampling with proportional allocation of sites across the *L* strata. Standard PSUs have two strata based on stream order, while the strata in "super-watersheds" consist of the constituent 8-digit watersheds (Table 2-3).

Table 2-3. The following symbols refer to the population of streams and the sample of sites .

Population	Sample	Defined as
N_r	n_r	Number of watersheds (PSUs) in region *r*
M_{rih}	m_{rih}	Number of 75-m sites in stratum *h* within PSU *i* in region *r*. A standard PSU has two strata: (1) 1st - 2nd order streams; and (2) 3rd - 4th order streams. For super-watersheds, the number of strata is equal to the number of 8-digit watersheds within the PSU.
Y_{rihj}	y_{rihj}	Variable of interest associated with site j, j=1,2,...,m_{rih}

For simplicity the subscript *r* for region in the estimators for watersheds was not included. For PSUs with collapsed strata, estimates of means, totals, and proportions are based on the standard estimators for simple random sampling (Cochran 1977).

For PSUs where stratification could be achieved, stratified estimators were used. Suppose m_{ih} sites are chosen randomly in stratum *h,* within watershed *i*, and, at each site *j,* measurements are collected for the variable of interest y_{ihj}. Standard stratified estimators (Cochran 1977) are used to estimate means, proportions, and totals when all randomly selected sites in watershed *i* are sampleable, and the number of stream miles can be determined directly from the sample frame. An estimator for the mean of the variable of interest *y* is

$$\bar{y}_i = \sum_{h=1}^{L} w_h \bar{y}_h$$

where

$$\bar{y}_h = \frac{1}{m_{ih}} \sum_{j=1}^{m_{ih}} y_{ijk}$$

is the mean of *y* for watershed *i* within stratum *h* and w_h is the proportion of stream miles in the stratum (determined from the sample frame). The variance of the stratified mean for *y* in watershed *i* is

$$\mathrm{Var}\left(\bar{y}_i\right) = \sum_{h=1}^{L} w_{ih}^2 \frac{s_{ih}^2}{m_{ih}}$$

where

$$s_{ih}^2 = \frac{1}{m_{ih}} \sum_{j=1}^{m_{ih}} y_{ihj}$$

is the sample variance for the variable of interest in stratum *h* for watershed *i*. An estimator for the standard error of $\bar{y}_i$ is

$$\sqrt{\mathrm{Var}\left(\bar{y}_i\right)}\ .$$

The same estimators can be used to estimate proportions of stream miles in a specific class by introducing an indicator variable that takes the value 1 when the variable *y* meets the condition (e.g., pH < 6), and zero otherwise. The mean of this indicator using the estimators above is an estimate of the proportion of stream miles within the specific class (e.g., proportion of stream miles with pH < 6). When estimating proportions, the MBSS samples can be treated as repeated independent samples of binary observations (1 if pH < 6, and 0 otherwise) because the samples have equal inclusion probabilities. An exact confidence interval for an estimated proportion (p) is obtained from the binomial distribution (Collett 1999, pp. 23-24), with lower and upper confidence bounds

$$p_L = y[y + (n - y + 1)F_{2(n-y+1),2y}(\alpha/2)]^{-1}$$

$$p_U = (y+1)[y + 1 + (n - y)F_{2(y+1),2(n-y)}(\alpha/2)]^{-1}$$

respectively, where $F_{v1,v2}(\alpha/2)$ is the upper $(100\alpha/2)$% point in the F-distribution with v_1 and v_2 degrees of freedom, and y is the observed number of successes (e.g., number of sites with IBI < 3) out of the n observations in a watershed.

An estimator for the total of a variable of interest (e.g., number of fish) in a watershed *i* is obtained by extrapolating the mean to all stream miles

$$\bar{Y}_i = M_i \bar{y}_i$$

with standard error

$$M_i \sqrt{Var}(\bar{y}_i).$$

In practice some of the random sites selected in a watershed *i* may fall outside the defined target streams for MBSS. During periods of drought, for example, sections of streams represented on the 1:100,000-scale map used in MBSS may not exist. Also, because of imperfections in the sample frame, some selected sites may fall outside the actual network of target streams defined by MBSS. Loss of samples was anticipated in the MBSS, and a list of randomly selected replacement sites was provided for the sampling crews. For the MBSS, estimates are made for the target streams, which may be a subpopulation of streams within an imperfect sample frame. This subpopulation is referred to as a *domain of study* (U.N. Subcommission on Sampling 1950).

For the MBSS, unsampleable streams are outside the domain of study. In this case, the Survey is interested in estimating parameters for the domain of study, i.e., for "MBSS target streams." All samples in watershed *i* can be treated as a simple random sample of size m_i, because samples were allocated to strata proportional to their stream length. This assumption is reasonable because the sampling fractions in the strata are equal, and each stream site has the same probability of being selected. Let the domain of study (MBSS target streams) in watershed *i* contain M'_{di} stream miles, and let m'_i be the number of sites of the simple random sample of size m_i that happens to fall in this domain. If (k=1,2,…, m'_i) are the measurements of the variable of interest from these sites, the mean for domain *d* is estimated by

$$\bar{y}_{id} = \sum_{k=1}^{m'_i} \frac{y'_k}{m'_i}$$

and an estimate for the standard error of $\bar{y}_{id}$ is

$$\frac{S_{id}}{\sqrt{m'_i}}$$

where

$$S^2_{id} = \sum_{k=1}^{m'_i} \frac{(y'_k - \bar{y}_{id})^2}{m'_i - 1}$$

The finite population correction factor can safely be ignored because the sampling fraction (i.e., the number of 75-m segments sampled relative to all available) within each watershed is small.

2.3.1.2 Estimators for Combining MBSS with Additional Probability-based Sampling Programs

When additional MBSS compatible data for a watershed are available from a probability-based sampling program, it is possible to combine the data by using a composite estimator (Vølstad et al. 2002). Assume that MBSS and a County program provide simultaneous estimates of the mean IBI for a watershed, and that the total length of streams covered by each survey *j* is L_j. The combined mean IBI for the watershed can then be estimated by a linear combination of the individual survey weighted means (Korn and Graubard 1999) $\bar{y}_1$ and $\bar{y}_2$,

$$\bar{y} = \frac{(k_1 L_1)\bar{y}_1 + (k_2 L_2)\bar{y}_2}{k_1 L_1 + k_2 L_2}.$$

If $\bar{y}$ and $\bar{y}_2$ are approximately unbiased for the population mean IBI, then $\bar{y}$ will also be unbiased. The variance of $\bar{y}$ is minimized by using the weights

$$k_j = \frac{L_1 + L_2}{2L_j}\left(1 - \frac{Var(\bar{y}_j)}{Var(\bar{y}_1) + Var(\bar{y}_2)}\right),$$

which grant more influence to precise estimates and greater survey coverage.

To estimate the variance of the combined mean $\bar{y}$ assume that each survey j has S_j number of strata; j = 1,2. The population of stream segments in the watershed is treated as if it was composed of $S = S_1 + S_2$ strata. This stratification controls for survey differences (Korn and Graubard 1999). When the two surveys are independent,

$$Var(\bar{y}) = \sum_{i=1}^{S} w_i^2 Var(\bar{y}_1)$$

where the strata weights

$$w_i = \frac{L_i}{\sum_{i=1}^{S} L_i}$$

are the fractions of the total stream length (for both surveys) in each stratum. An estimator for the standard error of $\bar{y}$ is

$$\sqrt{Var(\bar{y})}.$$

The same estimators can be used to estimate proportions of stream miles in a specific class by introducing an indicator variable that takes the value 1 when the variable *y* meets the condition (e.g., pH < 6), and zero otherwise. The mean of this indicator using the estimators above is an estimate of the proportion of stream miles within the specific class (e.g., proportion of stream miles with pH < 6). The estimation of exact confidence intervals for pooled data based on the binomial distribution (section 2.3.1.1) is valid only if the County program also employs simple random or an equivalent sampling design.

2.3.1.3 Estimators for Combining MBSS Data Across Sampling Rounds

While IBI data from the two rounds (e.g., 1996 and 2000 data) cannot simply be pooled because of the different study designs, the mean IBIs from the two rounds can be combined. In a watershed where there are sufficient samples in each round to calculate a mean and standard error, the estimates for each round can be combined into a single estimate using composite estimation (Korn and Graubard 1999). It is recommended that the combined estimate only be applied when the combined data represent an effective sample size of at least 10 samples. For MBSS Round One, a minimum of two samples per stratum are required (i.e., two samples in each of stream orders 1, 2, and 3).

Assume that two rounds provide estimates for the same population of streams, as defined on the 100,000 scale map, and that the two surveys were independent. Under this assumption temporal differences in the actual stream network caused by variation in rainfall or other factors are not taken into account. Let $\bar{x}_1$ and $\bar{x}_2$ be the mean IBIs for two rounds, with respective standard errors SE_1 and SE_2 calculated according to the respective survey design. Equal weights are assigned to each year's estimate, and use the simple combined estimator

$$\bar{x} = \frac{\bar{x}_1 + \bar{x}_2}{2}$$

for the pooled mean IBI, with variance

$$\mathrm{var}(\bar{x}) = \frac{1}{4}\{\mathrm{var}(\bar{x}_1) + \mathrm{var}(\bar{x}_2)\}$$

and standard error

$$SE = \frac{1}{2}\sqrt{SE_1^2 + SE_2^2}\ .$$

This simple approach was applied to avoid that the combined mean would be driven by the estimate for one particular year. When more than one survey is conducted in a watershed during the same year it is recommended that the means be weighted based on sample sizes or their variances (Korn and Graubard 1999). When significant differences occur between the sampling frames for two surveys in a watershed because of differences in maps scale (1:24,000 verus 100,000, for example), and their variances this should also be accounted for by adjusting the weights (Korn and Graubard 1999; Vølstad et al. 2002).

The difference in map scale between the two MBSS sampling rounds (1:250,000 versus 1:100,000) is likely to have only a small effect on the mean IBI scores because the network of streams on the two maps approximately overlaps. The 1:100,000 map includes a certain number of small headwater streams that are not included on the 1:250,000 map.

2.3.1.4 Testing for Differences in Mean IBI Scores Between Years

Comparisons of statistical differences between mean IBI scores from two years were conducted using the standard method recommended by Schenker and Gentleman (2001). This test was used because it is more robust than the commonly used method of examining the overlap between the two associated confidence intervals. Assume that $\hat{Q}_1$, and $\hat{Q}_2$ are two independent estimates of mean IBI, and that the associated standard errors (*SE*) are estimated by $\hat{S}E_1$ and $\hat{S}E_2$. We estimated the 95% confidence interval for $\hat{Q} - \hat{Q}_2$ by

$$\left(\hat{Q}_1 - \hat{Q}_2\right) \pm 1.96\left[\hat{S}E_1^2 + \hat{S}E_2^2\right]^{1/2}$$

However, the MBSS IBI scoring is only applied to streams in catchments over 300 acres, and thus it is reasonable to assume that the target population of streams are the same across rounds.

and tested (at 5% nominal level) the null hypothesis that $\hat{Q} - \hat{Q}_2 = 0$ by examining whether the 95% confidence interval contains 0. The null hypothesis that two estimates are equal was rejected if and only if the interval did not contain 0 (Schenker and Gentleman 2001).

2.4 LANDOWNER PERMISSION RESULTS

As discussed in Section 2.2.5, permissions were obtained to access privately owned land adjacent to or near each stream segment. For 2002, the overall success rate for obtaining permissions was 67% (Table 2-4). Cases where permissions were not obtained included both denials (7%) as well as non-responses (25%), when landowners were unable to be reached and did not respond to letters and telephone messages. The success rate was 89% for landowners who responded to phone or letter permission requests. Reasons for permission denial varied

Table 2-4. Landowner permission success rates for Primary Sampling Units (PSUs) sampled in the 2002 MBSS

PSU	Number of Stream Segments Targeted as Potential Sample Sites	Success Rate	No Response	Denial Rate
Back River	20	90%	10%	0%
Breton/St. Clements Bays	20	70%	20%	10%
Conewago Creek/Double Pipe Creek	34	71%	23%	6%
Conococheague	22	82%	13%	5%
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	30	50%	30%	20%
Gunpowder River/Lower Gunpowder Falls/ Bird River/Middle River-Browns	20	75%	25%	0%
Jones Falls	20	70%	5%	25%
Loch Raven Reservoir	34	53%	44%	3%
Lower Pocomoke	20	65%	10%	25%
Middle Chester River	20	70%	20%	10%
Middle Patuxent River	20	60%	40%	0%
Nanticoke River	30	50%	40%	10%
Potomac River Lower Tidal/ Potomac River Middle Tidal	20	65%	45%	0%
Potomac River Montgomery County	30	66%	24%	10%
Potomac River Washington County/ Marsh Run/Tonoloway/Little Tonoloway	36	50%	42%	8%
Rocky Gorge Dam	20	60%	35%	5%
Savage River	29	72%	20%	8%
South River/West River	20	80%	15%	5%
Town Creek	20	80%	10%	10%
TOTAL	465	67%	25%	7%

widely and generally reflected the preferences of individual landowners regarding property access, rather than any specific types of land. In rare cases, permission denial may affect the interpretation of MBSS estimates, but only where denials occur in streams with characteristics that differ from the general population of streams. During 2002 sampling, it did not appear that permission denials affected MBSS estimates although it was felt by field crews that permission denials in some PSUs may have resulted in more sites sampled on public lands than was proportionate to the amount of public land in the PSU.

2.5 NUMBER OF SITES SAMPLED IN 2002

As stated in Section 2.2.3.2 above, the target sample size in each PSU is a minimum of 10 sites for the spring benthic sampling. Additional sites were allocated to the larger PSUs sampled in 2002: Conewago Creek/Double Pipe Creek (7 extra), Loch Raven Reservoir (7 extra), Savage River (7 extra), Potomac River Montgomery County (5 extra), and Potomac River Washington County/Marsh Run/ Tonoloway/ Little Tonoloway (3 extra). Table 2-5 lists the number of sites sampled for spring benthic, physical habitat, and water chemistry sampling. For all PSUs, the number of sites actually sampled equaled or exceeded the target number specified in the design. Thirty-eight sites were unsampleable in the spring for a variety of reasons, including dry stream beds and impoundments. Dry streams were a significant problem in 2002 due to statewide drought conditions.

During summer sampling, a number of sites that had been sampled in the spring were unsampleable for several reasons, the most common being that the stream had dried up. Table 2-6 lists the number of sites that were electrofished during the summer of 2002. It also lists the number of sites where summer habitat and water quality measures were taken, as well as the number of sites where amphibians and reptiles, mussels, and aquatic vegetation were qualitatively sampled.

Table 2-5. Number of sites sampleable in the spring for MBSS 2002 PSUs

PSU	Number of Unsampleable Sites	Number of Benthic Sites	Number of Spring Habitat Sites	Number of Spring Water Quality Sites
Back River	1	10	10	10
Breton/St. Clements Bays	2	10	10	10
Conewago Creek/Double Pipe Creek	2	17	17	17
Conococheague	8	10	10	10
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	3	10	10	10
Gunpowder River/Lower Gunpowder Falls/ Bird River/Middle River-Browns	0	10	10	10
Jones Falls	0	10	10	10
Loch Raven Reservoir	0	17	17	17
Lower Pocomoke	3	10	10	10
Middle Chester River	4	10	10	10
Middle Patuxent River	0	10	10	10
Nanticoke River	2	10	10	10
Potomac River Lower Tidal/Potomac River Middle Tidal	2	10	10	10
Potomac River Montgomery County	2	15	15	15
Potomac River Washington County/ Marsh Run/Tonoloway/Little Tonoloway	5	13	13	13
Rocky Gorge Dam	0	10	10	10
Savage River	0	17	17	17
South River/West River	1	10	10	10
Town Creek	3	10	10	10
TOTAL	38	219	219	219

Table 2-6. Number of sites sampleable in the summer for MBSS 2001 PSUs						
PSU	**Number of Sites Fished**	**Number of Summer Habitat Sites**	**Number of Summer Water Quality Sites**	**Number of Sites - Amphibians and Reptiles**	**Number of Sites - Mussels**	**Number of Sites - SAV**
Back River	10	10	10	10	10	10
Breton/St. Clements Bays	5	5	5	8	5	5
Conewago Creek/Double Pipe Creek	15	15	15	15	15	15
Conococheague	10	10	10	10	10	10
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	10	10	10	10	10	10
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	9	9	9	9	9	9
Jones Falls	9	9	9	10	9	9
Loch Raven Reservoir	9	9	9	10	9	9
Lower Pocomoke	9	9	9	10	9	9
Middle Chester River	9	9	10	10	10	10
Middle Patuxent River	10	10	10	10	10	10
Nanticoke River	9	9	9	10	9	10
Potomac River Lower Tidal/ Potomac River Middle Tidal	7	7	10	7	7	7
Potomac River Montgomery County	14	14	14	14	14	14
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	9	9	11	9	9	9
Rocky Gorge Dam	10	10	10	10	10	10
Savage River	16	16	16	16	16	16
South River/West River	9	9	9	9	9	9
Town Creek	8	8	8	8	8	8
TOTAL	187	187	193	195	188	189

2.6 FIELD AND LABORATORY METHODS

2.6.1 Spring and Summer Index Periods

Benthic macroinvertebrate and water quality sampling were conducted in spring, when acidic deposition effects are often the most pronounced. While it is recognized that several different index periods may be used for benthic sampling, the MBSS chose the spring index period for logistical purposes. Fish, amphibian, reptile, and aquatic vegetation surveys, along with physical habitat evaluations, were conducted during the low-flow period in summer. Fish community composition tends to be stable during summer, and low flow is advantageous for electrofishing. Because low-flow conditions in summer may be a primary factor limiting the abundance and distribution of fish populations, habitat assessments were performed during the summer.

To reduce temporal variability, sampling was conducted within specific, relatively narrow time intervals, referred to as index periods. The spring index period was defined by degree-day limits for specific parts of the state. The spring index period was between March 1 and about May 1, with the end of the index period determined by degree-day accumulation as specified in Hilsenhoff (1987). In 2002, all spring samples were collected in March, well before degree-day accumulation limits were approached. The targeted summer index period was between June 1 and September 30(Kazyak 2001). In 2002, all summer sampling was completed by the end of August, well before the end of the targeted index period. While the spring index period is two months in duration because of changing weather conditions (possible rapid warming leading to changes in stream condition), the summer index period is four months long because weather conditions are more consistent throughout the season and fish sampling is more time consuming.

2.6.2 Water Chemistry

During the spring index period, water samples were collected at each site for analysis of water quality conditions, with an emphasis on factors related to acidic deposition and nutrients (Table 2-7). Grab samples were collected in 0.5 and 1-liter bottles for analysis of all analytes except pH. Water samples for pH were collected with 60 ml syringes, which allowed purging of air bubbles to minimize changes in carbon dioxide content (EPA 1987). Samples were stored on wet ice and shipped on wet ice to the analytical laboratory within 48 hours. The requirement to filter for some analytes within 48 hours was exceeded by several hours for some samples. Laboratory analyses were carried out by the University of Maryland's Appalachian Laboratory in Frostburg.

Chemical analysis of water samples followed standard methods as listed in Table 2-7. Routine daily quality control (QC) checks included processing duplicate, blank, and calibration samples according to EPA guidelines for each analyte. Field duplicates were taken at 5% of all sites. Routine QC checks helped to identify and correct errors in sampling routines or instrumentation at the earliest possible stage. Standard operating procedures were implemented that detail the requirements for the correct performance of analytical procedures. The internal QA/QC protocols followed guidelines outlined in EPA (1987). The complete QA/QC report for 2001 MBSS laboratory analysis can be found in Kline and Morgan (2002). QC results were examined in conjunction with site data and are summarized in a separate report (Rogers et al. 2003).

During the summer index period, in situ measurements of dissolved oxygen (DO), pH, temperature, and conductivity were collected at each site to further characterize existing water quality conditions that might influence biological communities. Measurements were made at an undisturbed section of the segment, usually in the middle of the stream channel and at the upstream segment boundary, using electrode probes.

Table 2-7. Analytical methods used for water chemistry samples collected during the spring index period .

Analyte (units)	Method	Instrument	Detection Limit	Holding Time (days)
pH (standard units)	EPA (1987) Method 19	Orion pH meter	0.01	7
Acid neutralizing capacity (μeq/l)	EPA (1987) Method 5	Brinkmann Automated Titration System equipped with customized software	0.01	14
Sulfate (mg/l)*	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.03	14
Nitrite nitrogen* (mg/l)	EPA (1999) Method 354.1	Lachat QuikChem Automated Flow Injection Analysis System	0.0005	28 (frozen)
Nitrate nitrogen* (mg/l)	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.01	14
Ammonia (mg/l)*	EPA (1999) Method 350.1	Lachat QuikChem Automated Flow Injection Analysis System	0.003	28 (frozen)
Total nitrogen (mg/l)*	APHA (1998) 4500-N (B)	Lachat QuikChem Automated Flow Injection Analysis System w/In-line Digestion Module	0.050	28 (frozen)
Orthophosphate (mg/l)*	APHA (1998) 4500-P (G)	Lachat QuikChem Automated Flow Injection Analysis System	0.0010	28 (frozen)
Total phosphorus (mg/l)*	APHA (1998) 4500-P (I)	Lachat QuikChem Automated Flow Injection Analysis System w/In-line Digestion Module	0.0013	28 (frozen)
Chloride (mg/l)*	EPA (1987) Method 11	Dionex DX-500 Ion Chromatograph (AS-9 HC column)	0.02	14
Specific conductance (μmho/cm)	EPA (1987) Method 23	YSI Conductance Meter w/Cell	0.1	7
Dissolved organic carbon (mg/l)*	EPA (1987) Method 14	Dohrmann Phoenix 8000 Organic Carbon Analyzer	0.14	28
Particulate carbon (mg/l)	D'Elia et al. (1997)	CE Elantech N/C Analyzer	0.0595	

* Indicates analyses that require filtration within 48 hours

Instruments were calibrated daily and calibration logbooks were maintained to document instrument performance. In 2002, there were no quality assurance problems apparent in log books and other documentation (Rogers et al. 2003).

2.6.3 Benthic Macroinvertebrates

Benthic macroinvertebrates were collected to provide a semi-quantitative description of the community composition at each sampling site. Sampling was conducted during the spring index period. Benthic community data were collected primarily for the purpose of calculating DNR's Benthic Index of Biotic Integrity (BIBI) for Maryland streams (Stribling et al. 1998). Recognizing that Maryland streams vary from high-gradient riffle habitat with abundant cobble substrate to low-gradient Coastal Plain streams with sandy or silty bottoms, MBSS employs a "D" net suitable for sampling a wide variety of habitats. This multi-habitat approach is consistent with the recommendations of the Mid-Atlantic Coastal Streams Workgroup (MACS 1996) and the EPA's most recent Rapid Bioassessment Protocols (Barbour et al. 1999).

At each segment, a 600-micron mesh "D" net was used to collect organisms from habitats likely to support the greatest taxonomic diversity. This habitat often includes a riffle area when present. Other habitats, in order of preference, include gravel, broken peat, or clay lumps in a run area; snags or logs that create a partial dam or are in run habitat; undercut banks and associated root mats; and SAV and detrital/sand areas in moving water. In riffles and most other habitats, sampling involved placing the net downstream, gently rubbing surficial substrates by hand to dislodge organisms, and disrupting deeper substrates using vigorous foot action. Each dip of the net covered one-two square feet, and a total of approximately 2.0 m^2 (20 square feet) of combined substrates was sampled; samples were preserved in 70% ethanol. Duplicate benthic samples were taken at 12 MBSS sites to assess the replicability of the field methods.

In the laboratory, the preserved sample was transferred to a gridded pan and organisms were picked from randomly selected grid cells until the cell that contained the 100th individual (if possible) was completely picked. Some samples had fewer than 100 individuals. The benthic macroinvertebrates were identified to genus, or lowest practicable taxon, in the laboratory. To aid in identification, oligochaete and chironomid taxa were slide-mounted and identified under a microscope. Laboratory QC procedures included the re-subsampling and identification of every 20th sample. This second sample was identified according to standard procedures and comparisons were made between the two duplicates. For the 2002 sampling year, samples from 12 sites were re-subsampled for QC purposes. The MBSS voucher specimen collection is currently maintained at the Maryland DNR Field Office in Annapolis, Maryland. A complete description of laboratory protocols can be found in Boward and Friedman (2000) and results of the QC analysis can be found in Rogers et al. (2003).

In macroinvertebrate monitoring, the decision to employ a particular subsample size (100 vs. 200 or greater) reflects a balance of how to best utilize program effort. While a larger subsample may improve precision in characterizing individual sites, each sample then requires additional effort for laboratory identification. If a program goal is better precision in characterizing watersheds, the added effort might be spent on a sampling more sites per watershed. At the outset of the MBSS monitoring program, a decision was made that 100-organism subsamples would provide acceptable precision at the single site level, and that, within a given total cost, effort would instead be focused on maximizing the total number of sites that could be sampled. However, DNR is interested in further investigating the effect of 100- vs. 200-organism subsampling.

2.6.4 Fish

Fish were sampled during the summer index period using double-pass electrofishing within 75-meter stream segments. Block nets were placed at each end of the segment and direct current backpack electrofishing units were used to sample the entire segment. An attempt was made to thoroughly fish each segment on each pass, sampling all habitat within the entire stream segment. A consistent effort was applied over the two passes. This sampling approach allowed calculation of several metrics constituting the biological index and produced estimates of fish species abundance.

In small streams, a single electrofishing unit was used. In larger streams, two or more were employed to effectively sample the site. Captured fish from each pass were identified to species, weighed in aggregate, counted, and released. Any individuals that could not be identified to species were retained for laboratory confirmation, and a voucher series of about 10 individuals was retained for each major (Maryland 6-digit) drainage basin. For each pass, all individuals of each gamefish species (defined as trout, bass, walleye, northern pike, chain pickerel, and striped bass) were measured for total length. For each species, unusual occurrences of visible external pathologies or anomalies were noted.

All voucher specimens and fish retained for positive identification in the laboratory were examined and verified by Dr. Rich Raesley, an ichthyologist at Frostburg State University, Frostburg, Maryland. All MBSS collections are archived in the fish museum at Frostburg State University.

2.6.5 Amphibians and Reptiles

At each segment sampled during the summer, amphibians and reptiles found during the course of electrofishing and other activities were captured, identified, and recorded. Individuals were identified to species when possible, but larval salamanders and tadpoles were not retained. Voucher specimens and individuals not positively identifiable in the field were retained for examination in the laboratory.

2.6.6 Mussels

During the summer index period, freshwater mussels were sampled by visual inspection at each 75-meter stream segment. The presence of Unionid mussels or Asiastic clam (*Corbicula fluminea*) was recorded as live, old shell, or recent shell.

2.6.7 Aquatic and Streamside Vegetation

During the summer index period, aquatic vegetation was sampled qualitatively by examining each 75-meter stream segment for the presence of aquatic plants. The presence and relative abundance of submerged, emergent, and floating aquatic vegetation were recorded.

In addition, the presence and relative abundance of invasive terrestrial plant species (e.g., multiflora rose) were recorded during summer sampling.

2.6.8 Physical Habitat

Habitat assessments were conducted during summer sampling at all stream segments as a means of assessing the importance of physical habitat to the biological integrity and fishability of freshwater streams in Maryland. Procedures for habitat assessment (Kazyak 2001) were derived from two commonly used methodologies: EPA's Rapid Bioassessment Protocols (RBPs) (Plafkin et al. 1989), as modified by Barbour and Stribling (1991), and the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) (Ohio EPA 1987, Rankin 1989).

During spring, riparian zone vegetation type and width on each bank was estimated to the nearest meter (up to 50 meters from stream). Severity and type of buffer breaks were noted. Local land use type and the extent and type of stream channelization were recorded and stream gradient was measured. Crews also recorded distance from road and assigned a trash rating (based on visible signs of human refuse at a site) to characterize human presence.

During summer sampling, several habitat characteristics (instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, and riffle/run quality) were assessed qualitatively on a 0-20 scale, based on visual observations within each segment. The percentage of embededdness of the stream channel and the percentage of shading of the stream site were estimated. Also recorded were the extent and severity of bank erosion and bar formation, number of woody debris and rootwads within the stream channel, and the presence of various stream features such as substrate types, various morphological characteristics, and beaver ponds. Maximum depth within the segment was measured. Wetted width, thalweg depth, and thalweg velocity were recorded at four transects. A complete velocity/depth profile was taken at one transect to compute discharge (streamflow); for sites with extremely low flow, the speed of a floating object was substituted to allow calculation of discharge.

Recognizing that water temperature is an important factor affecting stream condition (but one that varies daily and seasonally), the Survey deployed temperature loggers at most sites. A single Onset Computer Corporation Optic Stowaway model temperature logger was anchored in each sample site during the summer index period. They recorded the water temperature every 20 minutes from approximately June 1 until September 1. Field crews had the option of retrieving the loggers during summer sampling if the site was visited after August 15. In some cases, the same logger was used for two sites if they were close together on the same reach. Also, if a site was nearly dry in the spring, field crews may have elected not to deploy a logger.

2.7 QUALITY ASSURANCE

Quality assurance and quality control (QA/QC) are integral parts of the data collection and management activities of the Survey. The Survey employs well-established QA/QC procedures, as detailed in Kazyak (2001). Some key points are highlighted below.

2.7.1 Data Management

All crews used standardized pre-printed data forms developed for the Survey to ensure that all data for each sampling segment were recorded and standard units of measure were used. Using standard data forms facilitates data entry and minimizes transcription error. The field crew leader and a second reviewer checked all data sheets for completeness and legibility before leaving each sampling location. Original data sheets were sent to the Data Management Officer for further review, another signoff, and data entry, while copies were retained by the field crews.

A custom database application (written in Microsoft Access), in which the input module was designed to match each of the field data sheets, was used for data entry. Data were independently entered into two databases and compared using a computer program as a quality-control procedure. Differences between the two databases were resolved from original data sheets or through discussions with field crew leaders.

2.7.2 QA/QC for Field Sampling

A Quality Control Officer (QC Officer) experienced in all aspects of the Survey was appointed to administer the quality assurance program. Specific quality assurance activities administered by the QC Officer included preparing a field manual of standard sampling protocols, designing standard forms for recording field data, conducting field crew training and proficiency examinations, conducting field and laboratory audits, making independent habitat assessments, identifying taxa, reviewing all reports, and reporting errors.

To ensure consistent implementation of sampling procedures and a high level of technical competency, experienced field biologists were assigned to each crew and all field personnel completed program training before participating in field sampling. Training topics included MBSS program orientation, stream segment location using global positioning system (GPS) equipment, sampling protocols, operation and maintenance of sampling equipment, data transcription, quality assurance/quality control, and safety. The spring field crews received additional training in sampling protocols for water quality and benthic macroinvertebrates. The summer field crews received additional training in habitat assessment methods, taxonomy, and *in situ* water chemistry assessment.

Training included classroom, laboratory, and field activities. Instructors emphasized the objectives of the Survey and the importance of strict adherence to the sampling protocols. The QC Officer conducted proficiency examinations to evaluate the effectiveness of the training program and ensure that the participants had detailed knowledge of the sampling protocols. Members of the spring sampling crew were required to demonstrate proficiency in techniques for collecting samples for water chemistry and benthic macroinvertebrates. At least one member of each summer sampling crew was required to pass a comprehensive fish taxonomy examination. Each crew also demonstrated proficiency in locating pre-selected stream segments using the GPS receiver and determining if the segment was acceptable for sampling. Comprehensive "dry runs" were conducted to simulate actual field conditions and evaluate classroom instruction.

Field audits were conducted by the QC Officer during the field sampling to assess the adequacy of training, adherence to sampling protocols, and accuracy of data transcription. The audits included evaluation of the preparation and planning prior to field sampling, stream segment location using GPS equipment and assessment of acceptability for sampling, adherence to sampling protocols, data transcription, and equipment maintenance and calibration. The QC Officer made an independent assessment of habitat at all segments where field audits were done (approximately 7.5% of the total number of sites).

A separate QA report (Rogers et al. 2003) reports on details of QA activities for the 2001 sampling year.

2.8 CLIMATIC CONDITIONS

Because all flow in Maryland streams ultimately arises from precipitation, weather is an important factor in stream condition. In Maryland, annual precipitation varies geographically, averaging between 40 and 50 inches. In the western half of the state, the prevailing winds are from the west, typically mixing moisture from the south with colder temperatures from the north. Because of these prevailing winds and Maryland's mountain ridges (which create a rainshadow effect), rain and snowfall are greater in the west and precipitation tends to be heavier on west-facing slopes. In the eastern half of the state, prevailing winds are also westerly, but many storm events are also influenced by moisture from the coast and precipitation patterns there reflect that influence. These precipitation patterns have an obvious effect on runoff, a primary factor in determining stream characteristics. Because the flow of water (stream discharge) is one of the critical determinants of stream habitat quantity and quality, drier portions of the state should have less aquatic habitat than areas that are wetter.

Temporal changes in the amount of precipitation are also important in determining the amount of habitat available to aquatic organisms. Figures 2-3 through 2-7 show the monthly deviation from normal precipitation (in inches) for the years 1998-2000 (NOAA 1998, NOAA 1999, NOAA 2001, and NOAA 2002). This number is the average of the deviation from normal precipitation (calculated using 100 years of precipitation data) in eight regions of the state, so it is possible that some effects seen only in the eastern portion of the state may be masked by events in the western portion of the state and vice versa. Actual monthly values for each region are shown in Appendix A.

Beginning in 1998, precipitation was lower than normal in Maryland. In 2002, drought conditions worsened (Figure 2-7), leading the governor to declare a drought emergency. The City of Baltimore experienced the driest February, amid the fourth-driest winter, since recordkeeping began in 1871. By the end of February, water levels in Baltimore's reservoirs dipped below the lows reached during the drought of 1999. Mandatory restrictions on water consumption were imposed throughout the state. By August of 2002, the driest September to mid-August period in Baltimore was recorded since 1871. In the year from September 2000 to September 2001, Baltimore-Washington International Airport recorded 23.86 inches of precipitation, less than 57% of normal for the period and a deficit of more than 18 inches. Less than an inch of rainfall was recorded at the airport between July 27, 2002 and August 21, 2002. Conditions began to improve as Maryland recorded the wettest October in seven years – as much as 6 inches of rain was recorded in parts of Central Maryland. Wetter than normal conditions in November and December of 2002 also contributed to the end of the drought emergency in Maryland.

As a result of this period of low precipitation culminating in severe drought during the 2002 sampling year, it was expected that the abundance of fish and other aquatic organisms would be lower than previous years.

However, Sentinel Site CBI scores were not consistently low due to the drought and low flow conditions. At the same time, the drought did negatively impact a few sites in the Coastal Plain physiographic province. CORS-102-S-2002 and WCHE-086-S-2002 both went dry in the summer of 2002. In addition, MATT-033-S-2002 consisted only of a few standing pools and had the lowest FIBI score in the four years that it has been sampled. This illustrates that although the drought was widespread, only certain watersheds were adversely impacted during the drought."

In the future, the Survey will consider adjusting individual site fish and benthic IBI scores relative to the scores obtained at the Sentinel Sites.

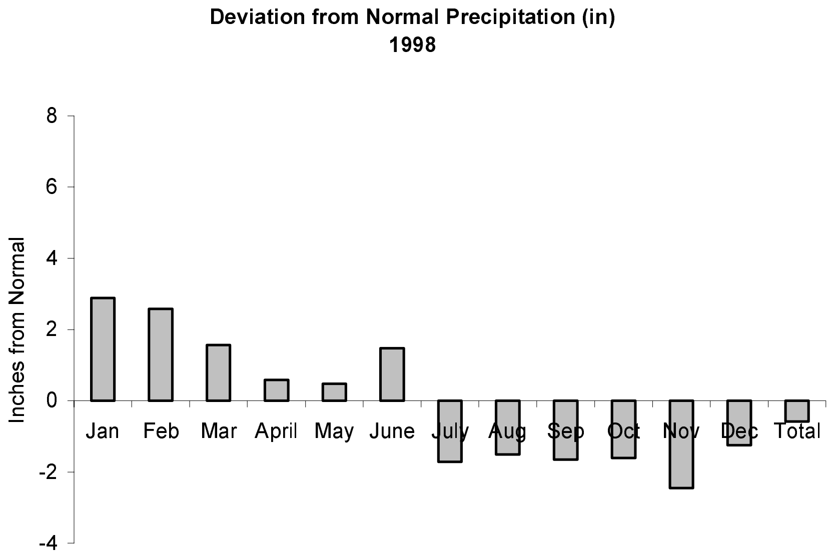


Figure 2-3. Statewide average deviation from normal precipitation during 1998

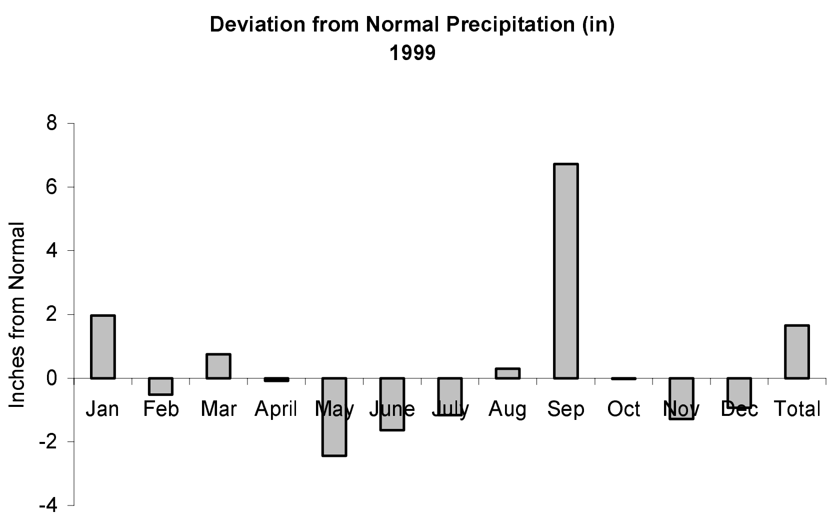


Figure 2-4. Statewide average deviation from normal precipitation during 1999

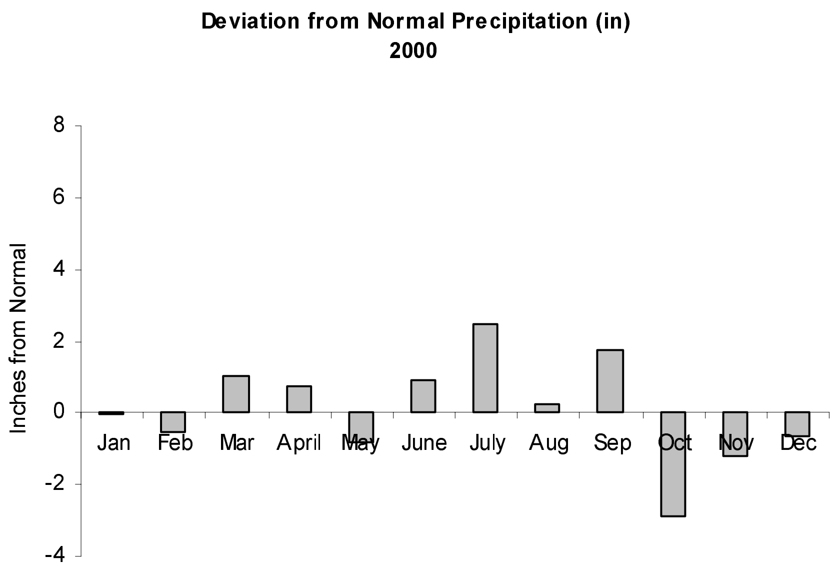


Figure 2-5. Statewide average deviation from normal precipitation during 2000

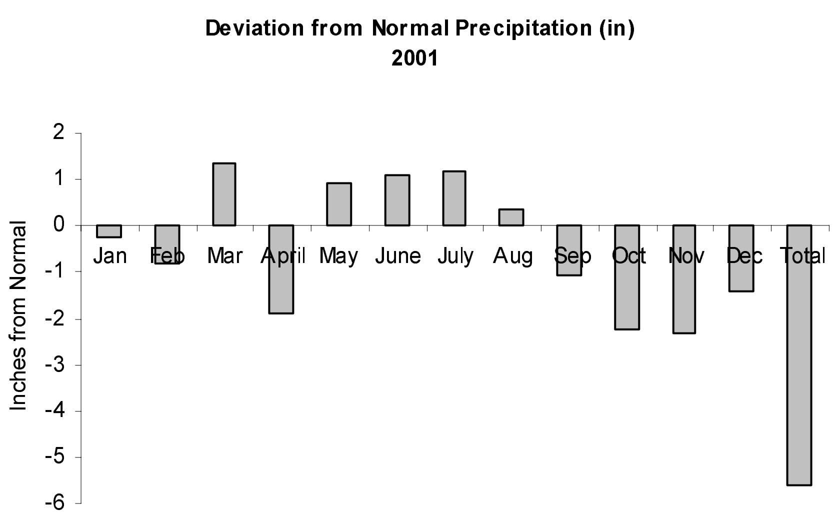


Figure 2-6. Statewide average deviation from normal precipitation during 2001

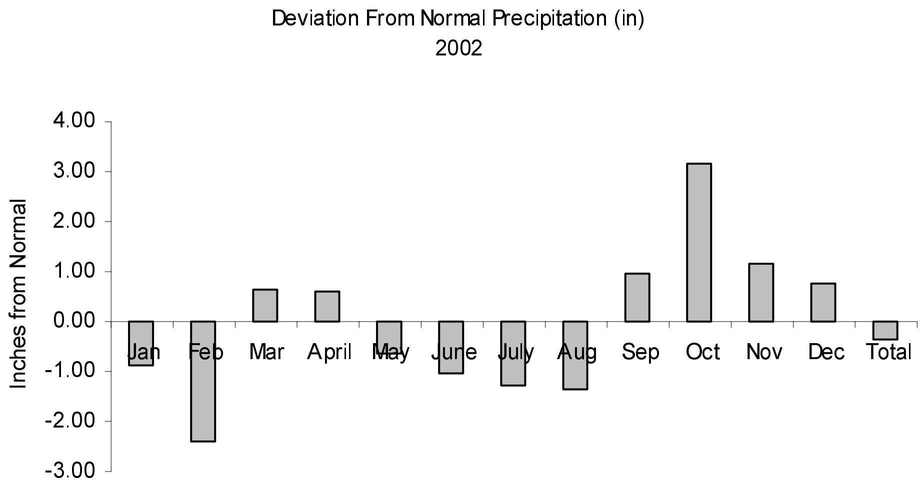


Figure 2-7. Statewide average deviation from normal precipitation during 2002

3 THE STATE OF THE STREAMS: COMPARATIVE ASSESSMENT OF WATERSHEDS SAMPLED IN 2002

This chapter provides a comparative assessment of the watersheds sampled by the MBSS (or Survey) in 2002. Separate sections focus on biodiversity, biological indicator results, and three predominant issues affecting biological resources: acidification, physical habitat, and nutrients and other water chemistry. The indicators used were developed during Round One of the MBSS and have been deemed reliable for representing ecological condition by field verification and expert peer review. Nonetheless, the MBSS continues to pursue refinements to its indicators including improvements to the provisional physical habitat index (PHI), methods for combining indicators that do not lose information (e.g., combined biotic index), and changes to the indicator thresholds and scoring methods to make them more intuitive and accessible to the public.

3.1 BIODIVERSITY

In addition to assessing the integrity of streams and watersheds, the Survey provides invaluable information on the abundance and distribution of rare species. Documenting the presence (and ultimately abundance in the five-year Round Two report) of rare species, the Survey supports a more thorough characterization of Maryland's aquatic biodiversity. During MBSS sampling in 2001, a substantial number of rare or unusual occurrences of fish were documented. This chapter presents a brief summary of particularly noteworthy findings. Four state-listed rare species were observed at MBSS sites in 2002: mud sunfish (*Acantharchus pomotis*), banded sunfish (*Enneacanthus obesus*), pearl dace (*Margariscus margarita*), and swamp darter (*Etheostoma fusiforme*). Complete taxa lists of fish, benthic macroinvertebrates, amphibians, and reptiles observed in each PSU are included in Chapter 4 of this report.

Four mud sunfish were found at one site in the Lower Pocomoke River and two were found at one site in the Nanticoke River. One banded sunfish was found at a site in the Lower Pocomoke River and seven were found at a sentinel site in Nassawango Creek. A total of 205 pearl dace were found at five sites in Conococheague.

In addition to state-listed fish species, two species found at less than 2% of the MBSS sites sampled in Round One were also collected in 2002: warmouth (*Lepomis gulosus*) and rainbow darter (*Etheostoma caeruleum*). One warmouth was found at one site in each of three PSUs: Eastern Bay PSU, Potomac River Lower Tidal/Potomac River Middle Tidal, and South/West River. The rainbow darter was found at two sites in Potomac River Montgomery County (5 individuals and 15 individuals, respectively) and at three sites in Town Creek (a total of 168 individuals).

No state-listed herpetofauna were found at MBSS sites in 2002.

3.2 BIOLOGICAL INDICATORS

The Index of Biotic Integrity (IBI) is a stream assessment tool that evaluates biological integrity based on characteristics of the fish or benthic assemblage at a site. Biological integrity is defined as

> *the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitat of the region.*
>
> -- Karr and Dudley (1981) as cited in Karr (1991)

To develop an IBI, reference sites are selected to represent regional natural habitats, also referred to as "minimally impacted" conditions. We recognize that no streams in Maryland are entirely undisturbed by human activities. Atmospheric deposition of contaminants alone reaches all parts of the State, few streams have natural temperature regimes, and more than 1,000 man-made barriers to fish migration have been documented in Maryland. Therefore, reference conditions currently in use should not be viewed as completely natural or pristine.

They are, however, a representative sample of the best streams that currently exist in the State. Whether these conditions are the best attainable depends on future restoration activities and the goals of DNR, other agencies, and the public.

Sites were evaluated using both the fish and benthic IBIs developed for the MBSS, indicators previously employed in evaluating Round One results (Roth et al. 1999). For details about IBI development, see Roth et al. (2000) and Stribling et al. (1998). IBI scores for each site were determined by comparing the fish or benthic assemblage to those found at minimally impacted reference sites. Three separate formulations were employed for the fish IBI, one for each of three distinct geographic areas: Coastal Plain, Eastern Piedmont, and Highlands. Two different formulations of the benthic IBI were used in the Coastal Plain and non-Coastal Plain regions. IBIs were calibrated specifically for each ecological region during their development.

The MBSS computes the IBI as the average of individual metric scores. Individual metric scores are based on comparison with the distribution of metric values at reference sites within each geographic stratum. Metrics are scored 1 (if < 10th percentile of reference value), 3 (10th to 50th percentile), or 5 (≥ 50th percentile). The final IBI scores are calculated as the average of three scores and therefore range from 1 to 5. An IBI ≥ 3 indicates the presence of a biological community with attributes (metric values) comparable to those of reference sites, while an IBI < 3 means that, an average, metric values fall short of reference expectations. Table 3-1 contains narrative descriptions for each of the IBI categories developed for the Survey.

Because an IBI score of 3 represents the threshold of reference condition, values less than 3 (i.e., poor or very poor) represent sites suspected to be degraded. In contrast, values greater than or equal to 3 (i.e., fair or good) indicate that most attributes of the community are within the range of those at reference sites. Highest scores (IBI of 4 to 5) were designated as good, recognizing that available reference sites do not necessarily represent the highest attainable condition nor are these sites pristine or completely natural. The assignment of scores to narrative categories is a useful method for translating scores into a form that is easily communicated.

The sections below contain a summary of biological indicator results for MBSS core sites sampled in 2002. Included are the fish IBI, benthic IBI, and an integrated summary of both bioindicators, the Combined Biotic Index (CBI), the average of the fish and benthic IBIs or if only one IBI exists for a site that score is used.

3.2.1 Fish IBI Results

Although a target of sampling 10 sites per PSU was set, in some cases fewer than 10 sites received fish IBI scores (Table 3-2). A total of 187 core sites in 19 PSUs were sampled for fish during summer 2002. Of these sites, 27 sites were not rated by the fish IBI, as they were very small headwater streams (each with a catchment area less than 300 acres) where expectations of fish abundance and diversity are too low for development of an effective indicator.

In addition, because the fish IBI may underrate coldwater and blackwater streams owing to their naturally low species diversity, evidence of these stream types was used as a secondary indicator in interpreting scores. Sites where brook trout were present (a clear sign of coldwater conditions) and where fish IBI scores were less than 3 were excluded from analysis and reported as “not rated.” This situation was rare (8 sites). Along with low species richness, naturally acidic blackwater streams may also be dominated by a few acid-tolerant species. Because of the concern for possibly underrating blackwater streams, the six blackwater streams with fish IBI scores less than 3 were excluded from analysis and were instead classified as “not rated.” Blackwater streams were defined as sites with either pH < 5 or ANC < 200 μeq/l and DOC > 8 mg/l. Over time, the Survey plans to build its database of coldwater and blackwater streams to the point where it can develop biological indicators particular to these special stream types.

Other factors that may affect fish IBI scores should be considered in interpreting scores for individual sites. Sites with natural features such as bedrock substrate or a small, shallow stream channel may naturally support few species.

Fish IBI scores for sites sampled in the 2002 MBSS spanned the full range of biological condition from 1.0 (very poor) to 5.0 (good). Fish IBI data for each PSU are depicted in Figure 3-1 and listed in Appendix Table B-1. Mean fish IBIs for PSUs sampled in 2000-2002 are mapped in Figure 3-2. Over the remaining two years of Round Two sampling, data will be collected in remaining PSUs to complete an updated statewide picture of biological conditions. Mean fish IBI by PSU ranged from

Table 3-1. Narrative descriptions of stream biological integrity associated with each of the IBI categories

Good	IBI score 4.0 - 5.0	Comparable to reference streams considered to be minimally impacted. On average, biological metrics fall within the upper 50% of reference site conditions.
Fair	IBI score 3.0 - 3.9	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of these minimally impacted streams. On average, biological metrics fall within the lower portion of the range of reference sites (10th to 50th percentile).
Poor	IBI score 2.0 - 2.9	Significant deviation from reference conditions, with many aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating degradation. On average, biological metrics fall below the 10th percentile of reference site values.
Very Poor	IBI score 1.0 - 1.9	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of these minimally impacted streams, indicating severe degradation. On average, biological metrics fall below the 10th percentile of reference site values; most or all metrics are below this level.

Table 3-2. Number of sites electrofished in summer 2001 (by PSU), numbers of special cases, and number of sites available for fish IBI (FIBI) analysis					
PSU	**Number of Sites Fished**	**Number of Sites < 300 acres**	**Number of Brook Trout Sites with FIBI < 3**	**Number of Blackwater Sites with FIBI < 3**	**Number of sites Available for FIBI**
Back River	10	1	0	0	9
Breton/St. Clements Bays	5	2	0	0	3
Conewago Creek/Double Pipe Creek	15	2	0	0	13
Conococheague	10	0	0	0	10
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	10	2	2	0	6
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	9	1	0	0	8
Jones Falls	9	0	0	0	9
Loch Raven Reservoir	9	5	0	1	3
Lower Pocomoke	9	1	4	0	4
Middle Chester River	9	0	0	0	9
Middle Patuxent River	10	2	0	0	8
Nanticoke River	9	0	0	0	9
Potomac River Lower Tidal/Potomac River Middle Tidal	7	2	0	0	5
Potomac River Montgomery County	14	0	0	0	14
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway	9	2	0	0	7
Rocky Gorge Dam	10	0	0	0	10
Savage River	16	0	0	7	9
South River/West River	9	7	0	0	2
Town Creek	8	0	0	0	8
TOTAL	187	27	6	8	146

1.96 (Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway PSU, referred to from now on as the Potomac River Washington County PSU) to 3.85 (Eastern Bay/Kent Narrows/Lower Chester River/ Langford Creek/Kent Island Bay PSU, referred to from now on as the Eastern Bay PSU).

Data were also used to estimate the extent of streams in poor to very poor condition within each PSU. The MBSS Round Two study design, based on simple random sampling, makes it possible to calculate an exact confidence interval around each estimate based on the binomial distribution. The extent of streams within a given condition (e.g., IBI < 3) is expressed as a percentage of all first- through fourth-order stream miles in the PSU, with an associated 90% confidence interval around the estimate. The 90% confidence interval was selected as the most appropriate for balancing the variability of the data and the need for information to support management decisions. This recognizes that requiring very high confidence can lead to an unnecessarily large number of decisions not to act.

Figure 3-3 shows the 90% confidence intervals for the percentage of stream miles with fish IBI < 3, by PSU. Values are listed in Appendix Table B-2. Results indicate the Eastern Bay PSU has the least extensive occurrence of poor to very poor fish IBI scores. With 90% confidence, we can say that only 0-55% of stream miles in this PSU had poor to very poor fish IBI scores. In contrast, with 90% confidence we can say that 59 to 97% of stream miles in Conewago Creek/Double Pipe Creek had poor to very poor fish IBI scores.

Note that the confidence intervals are most narrow where (1) conditions tend to be homogeneous (i.e., one condition occurs at all or nearly all sites, whereas the alternative condition occurs at 0 or few sites) and (2) the number of samples is high. For PSUs with small sample size, the confidence interval is, as expected, fairly wide. Completion of all Round Two sampling by 2004 will allow estimation of statewide and basin-specific conditions. At the basin level, larger sample sizes will result in much narrower confidence intervals, with precision comparable to Round One basin results.

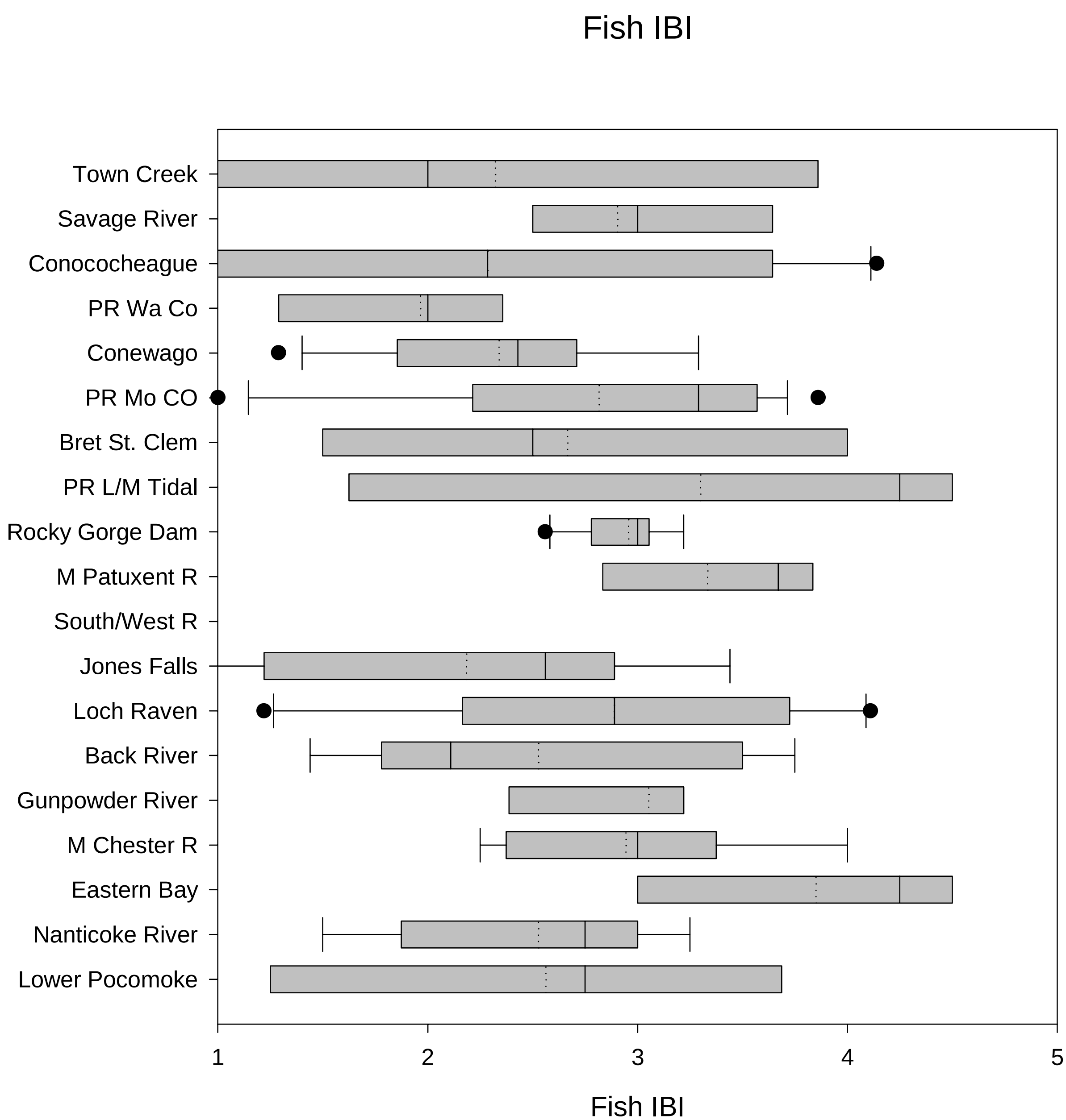


Figure 3-1. Distribution of fish Index of Biotic Integrity (IBI) scores for the MBSS PSUs sampled in 2002. The solid vertical line indicates the median value of the data, while the dotted line indicates the mean value. The grey box delineates the 25th and 75th percentiles of the data, while the whiskers indicate the 10th and 90th percentiles of the data. Dotes indicate outliers.

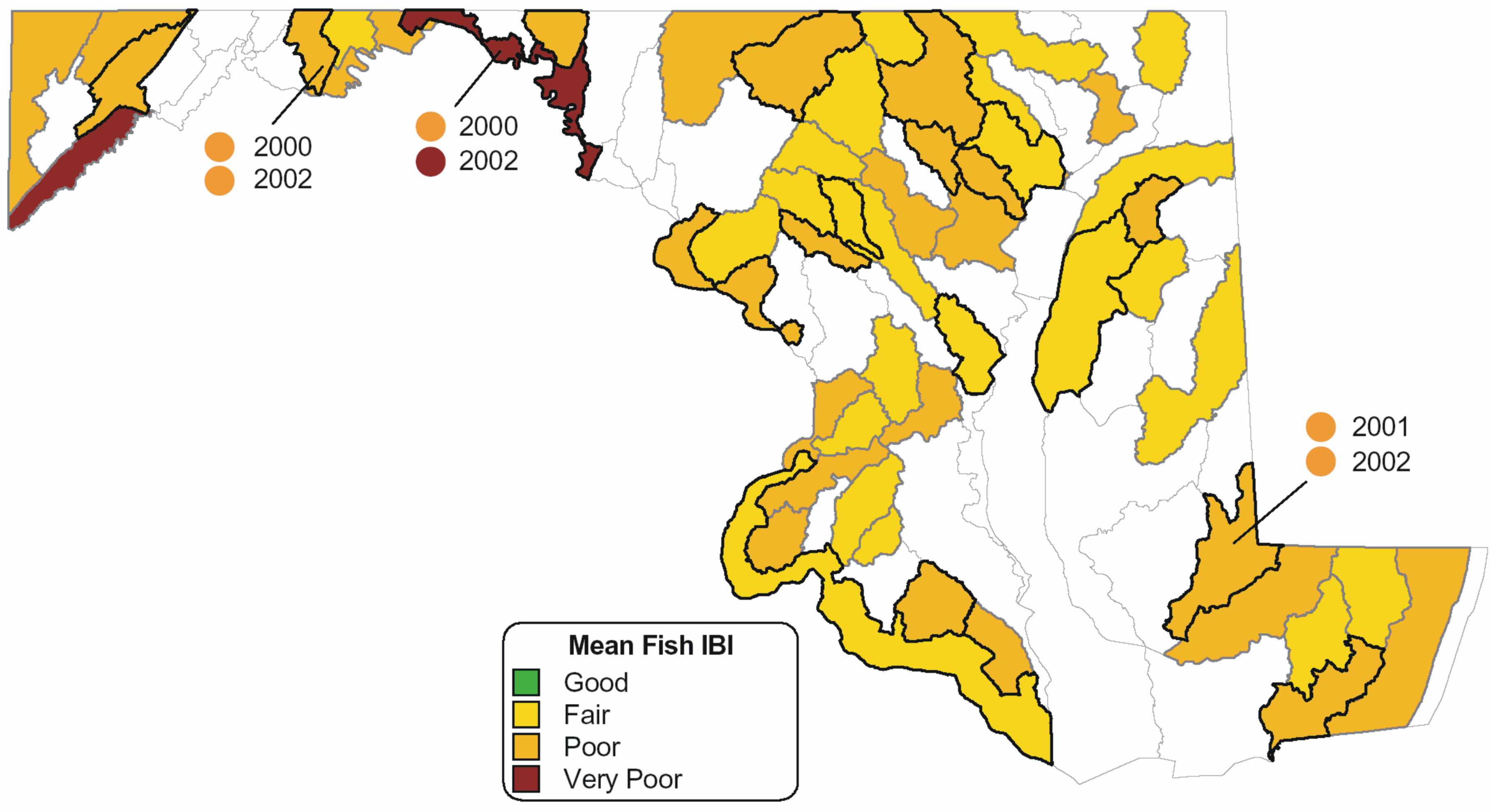


Figure 3-2. Mean fish Index of Biotic Integrity (IBI) in MBSS PSUs sampled in 2000, 2001, and 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

For the first three years of Round Two sampling, the percentage of stream miles in each of four categories of Fish IBI was calculated for the entire State. Statewide, 16% (standard error 0.02) if stream miles were rated Good, 28% (standard error 0.02) of stream miles were rated Fair, 14% (standard error 0.02) of stream miles were rated Poor, 14% (standard error 0.02) of stream miles were rated Very Poor, and 28% (standard error 0.02) of stream miles were Not Rated.

A snapshot of good and bad conditions is illustrated by sites with the 10 best and 10 worst Combined Biotic Index (CBI) scores. Sites with the worst scores represented a broad range of stream problems. Significant impacts are noted at urban streams in heavily developed areas with extensive impervious surface and little or no riparian vegetation agricultural impacts were noted at several streams in southern Maryland and on the eastern shore. Channelization was common in both rural and urban streams.

10 best sites in watersheds sampled by MBSS 2002, as rated by the Combined Biotic Index (CBI)

3.1.1.1.1 Stream Name	Site	Order	Basin	Watershed Name	CBI
TOMAKOKIN CR UT	STCL-112-R-2002	1	Lower Potomac River	St. Clements Bay	4.71
OWL BRANCH UT	LOCH-216-R-2002	2	Gunpowder River	Loch Raven Reservoir	4.56
DRY RUN	SAVA-104-R-2002	1	North Branch Potomac River	Savage River	4.56
BIG RUN WHISKEY HOLLOW UT	SAVA-105-R-2002	1	North Branch Potomac River	Savage River	4.56
EAST FORK LANGFORD CR UT 2	LAND-109-R-2002	1	Chester River	Langford Creek	4.46
BEAR PEN RUN	SAVA-117-R-2002	1	North Branch Potomac River	Savage River	4.33
SAVAGE R	SAVA-308-R-2002	3	North Branch Potomac River	Savage River	4.21
REEDER RUN	PRMT-315-R-2002	3	Lower Potomac River	Potomac River Middle Tidal	4.20
MOLL DYERS RUN	BRET-101-R-2002	1	Lower Potomac River	Breton Bay	4.14
NORTH BR	JONE-107-4-2002	1	Patapsco River	Jones Falls	4.11

Sites with the best scores were distributed across the state. As expected, many drained forested catchments less disturbed by human impacts. None had a high degree of urbanization. The relative influence of agriculture varied, but the best sites highlighted here tended to have good riparian buffer and good physical habitat, even when located in a highly agricultural catchment.

10 best sites in watersheds sampled by MBSS 2002, as rated by the Combined Biotic Index (CBI)

3.1.1.1.2 Stream Name	Site	Order	Basin	Watershed Name	CBI
WILLETT BR	PRMO-109-R-2002	1	Potomac Washington Metro	Potomac River Montgomery County	1.00
CONOCOCHEAGUE CR UT 2	CONO-105-R-2002	1	Upper Potomac River	Conococheague	1.22
STONY RUN	JONE-102-R-2002	1	Patapsco River	Jones Falls	1.22
STONY RUN UT	JONE-105-R-2002	1	Patapsco River	Jones Falls	1.22
CONOCOCHEAGUE CR UT 2	CONO-1-R-2002	1	Upper Potomac River	Conococheague	1.37
WAGRAM SWAMP BR	LOPC-101-R-2002	1	Pocomoke River	Lower Pocomoke River	1.43
TOWN CR UT 2	TOWN-111-R-2002	1	Upper Potomac River	Town Creek	1.44
MILL SWAMP RUN UT 1	PRMT-201-R-2002	2	Lower Potomac River	Potomac River Middle Tidal	1.54
STEMMERS RUN	BACK-110-R-2002	1	Patapsco River	Back River	1.56
BROOKS RUN UT 1	BRET-103-R-2002	1	Lower Potomac River	Breton Bay	1.57

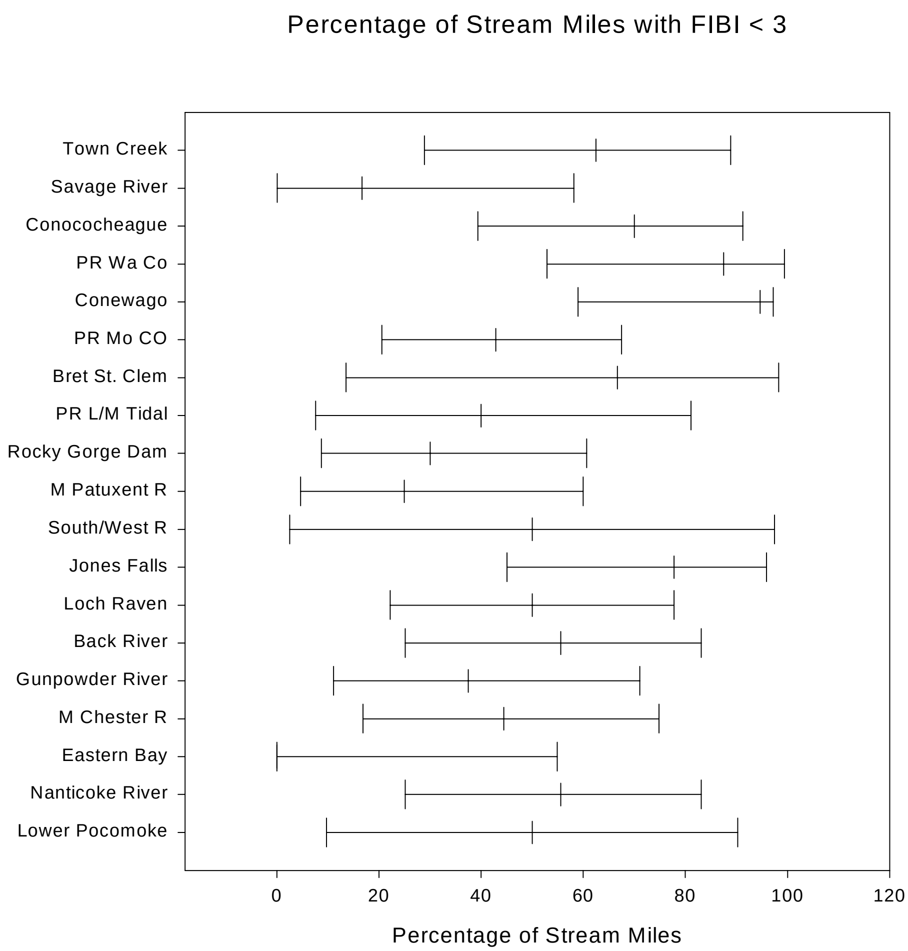


Figure 3-3. Percentage of stream miles with fish Index of Biotic Integrity (IBI) scores < 3.0 for the MBSS PSUs sampled in 2002

3.2.2 Benthic IBI Results

Benthic IBI scores were calculated for the 219 core sites sampled in spring 2002. Scores spanned the full range of biological conditions, from 1.0 (very poor) to 4.71 (good). Benthic IBI data for each PSU are shown in Figure 3-4 and listed in Appendix B-3. Mean benthic IBIs by PSU are mapped in Figure 3-5. The lowest mean benthic IBI was 1.86 in the Lower Pocomoke. The highest mean benthic IBI was 4.06 in Savage River.

The extent of occurrence of streams with benthic IBI < 3 was calculated, along with 90% confidence intervals. Values are listed in Appendix Table 3-4. As shown in Figure 3-6, an estimated 74 to 100% of stream miles in both Lower Pocomoke and Back River PSUs had benthic IBI < 3. In contrast, an estimated 0 to 30% of stream miles in Savage River had benthic IBI < 3.

Statewide, 22% (standard error 0.02) of stream miles were rated with Good BIBI scores, 34% (standard error 0.02) were rated Fair, 25% (standard error 0.02) were rated Poor, and 14% (standard error 0.02) were rated Very Poor.

3.2.3 Combined Biotic Index Results

To integrate the results of fish and benthic IBI assessments, a Combined Biotic Index (CBI) was assigned to each site. If both IBI scores were available for a site, the CBI was calculated as the mean of the fish and benthic IBI values. If only one score was available (e.g., benthic IBI but no fish IBI), the single score was assigned as the CBI. Interpretation of the CBI scores follows the guidelines in Table 3-2.

CBI scores from core MBSS sites ranged from 1.00 (very poor) to 4.71 (good). CBI data for each PSU are depicted in Figure 3-7 and listed in Appendix Table B-5. Mean CBI values by PSU are mapped in Figure 3-8. Mean CBI per PSU ranged from 1.96 (Lower Pocomoke) to 3.77 (Savage River), paralleling benthic IBI results. The 90% confidence intervals for percentage of stream miles with CBI < 3 are shown in Figure 3-9 and Appendix Table B-6.

Statewide, 14% (standard error 0.02) of stream miles were rated with Good CBI scores, 41% (standard error 0.02) were rated Fair, 28% (standard error 0.03) were rated Poor, and 17% (standard error 0.02) were rated Very Poor.

3.3 ACIDIFICATION

The effects of acidic deposition and acid mine drainage (AMD) on stream chemistry are well documented. Maryland's 1987 Synoptic Stream Chemistry Survey (MSSCS; Knapp et al. 1988) concluded that approximately one-third of all headwater streams in Maryland are sensitive to acidification or are already acidic. Acidification is known to cause declines in both the diversity and abundance of aquatic biota. Round One MBSS results (Roth et al. 1999) and an assessment of these results in comparison with critical loads (Miller et al. 1998) confirmed that stream acidification remains a problem in Maryland freshwater streams.

The defining characteristics of surface waters sensitive to acidification are low to moderate pH and acid neutralizing capacity (ANC). pH is a measure of the acid balance of a stream. The pH scale ranges from 0 to 14, with pH 7 as neutral and pH < 7 signifying acidic conditions. Biological effects are often noted at pH < 5 or 6, except in naturally acidic systems where aquatic biota can tolerate low pH. ANC is a measure of the capacity of dissolved constituents in the water to react with an neutralize acids and is used as an index of the sensitivity of surface water to acidification. The higher the ANC, the more acid a system can assimilate before experiencing a decrease in pH. Repeated additions of acidic materials can cause a decrease in ANC. In many acidic deposition studies (e.g., Schindler 1988), an ANC of 200 µeq/L is considered the threshold for defining sensitive streams and lakes.

By measuring pH, ANC, and several analytes indicative of potential acidification sources (e.g., sulfate, nitrate nitrogen, dissolved organic carbon (DOC), and agricultural land use), the Survey provides an opportunity to examine the current extent and distribution of stream acidification in Maryland watersheds. Results from the 2002 MBSS sampling are presented below.

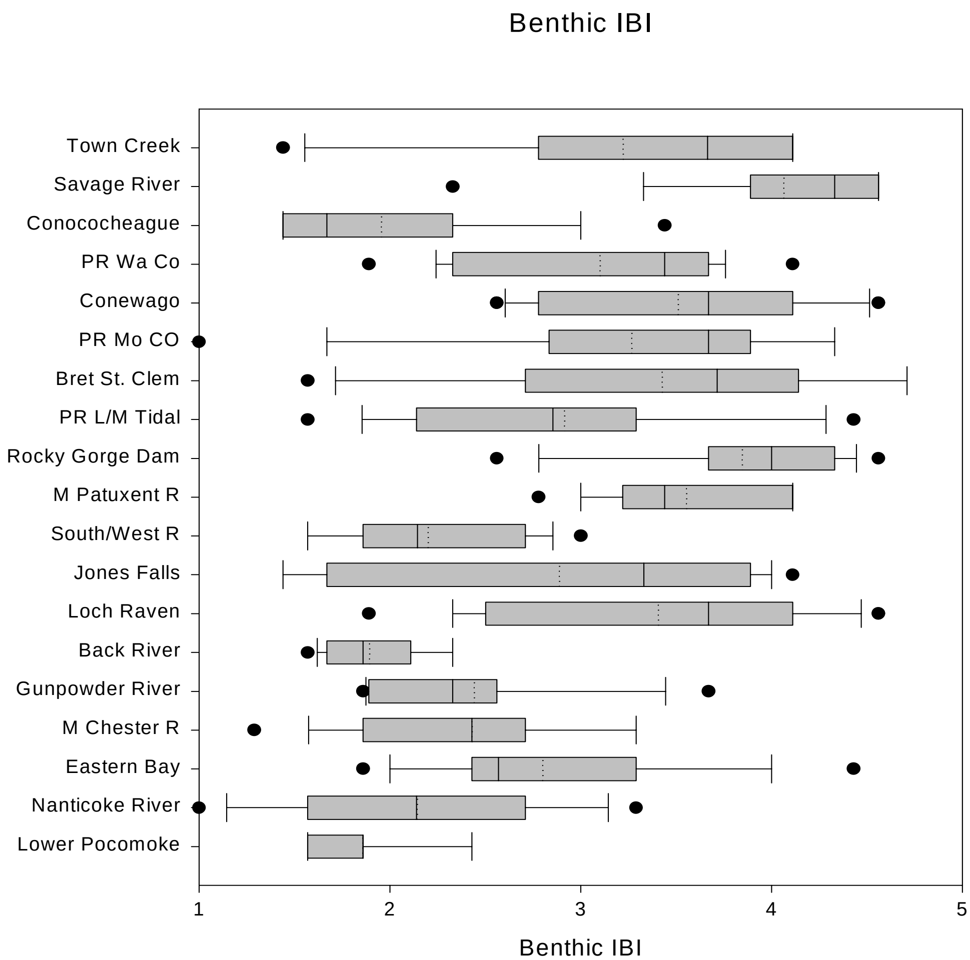


Figure 3-4. Distribution o f benthic Index of Biotic Integrity (IBI for MBSS PSUs sampled in 2002

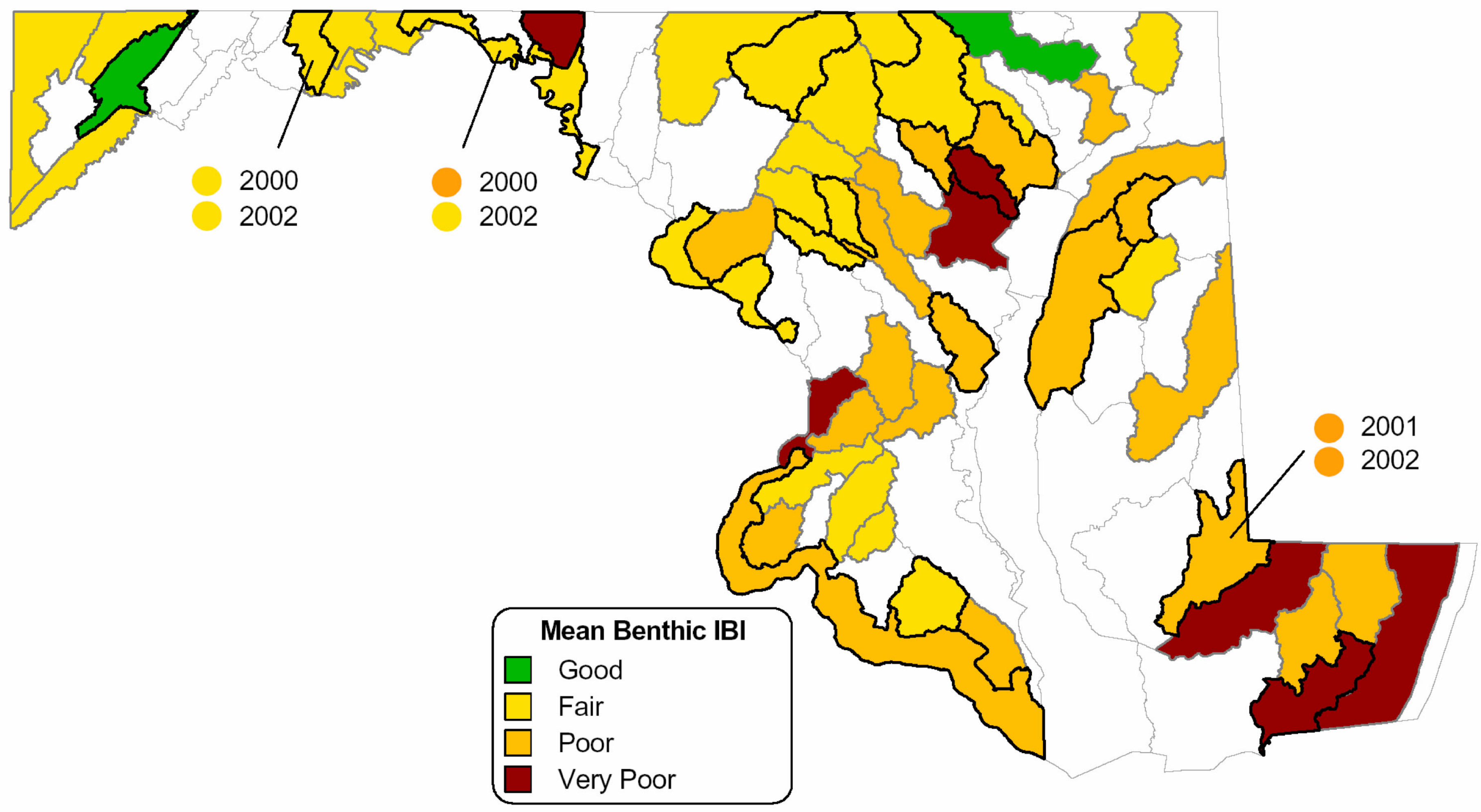


Figure 3-5. Mean benthic Index of Biotic Integrity (IBI) in MBSS PSUs sampled in 2000, 2001, and 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

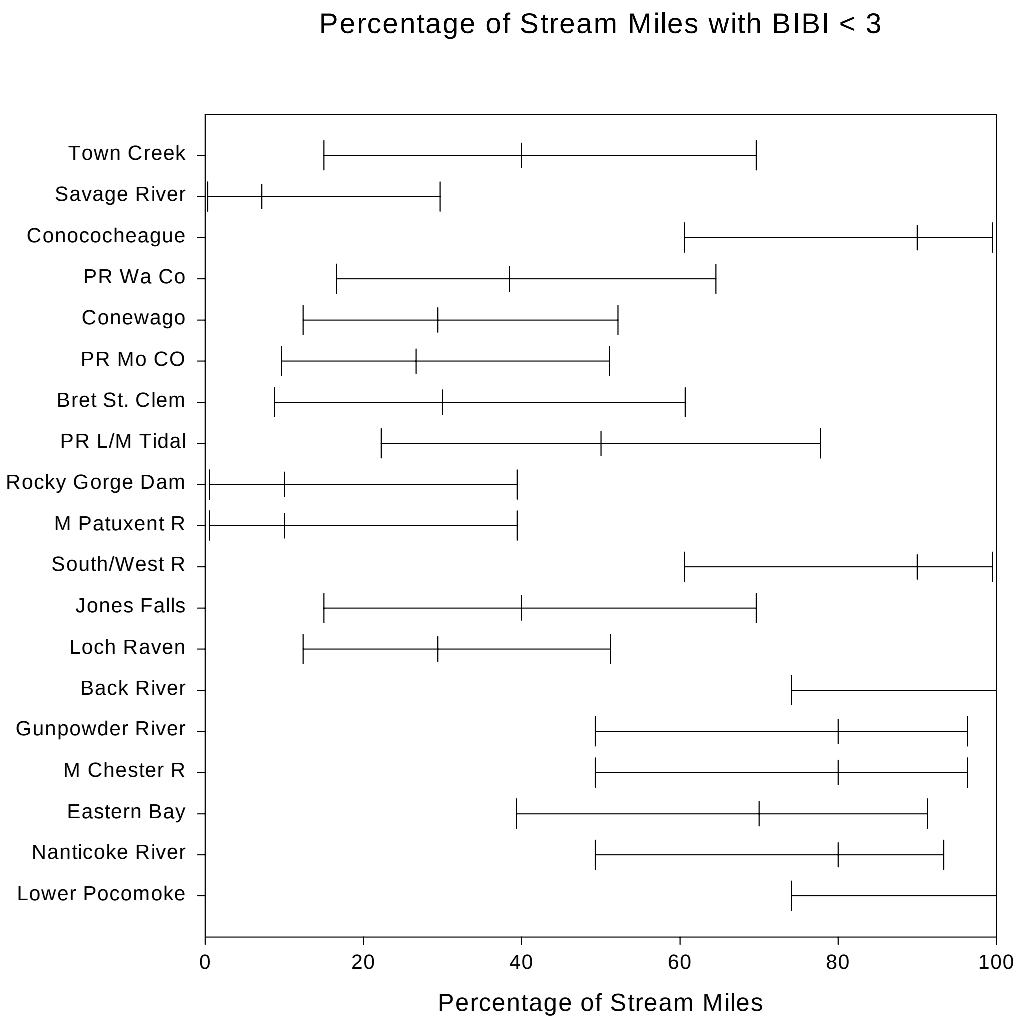


Figure 3-6. Percentage of stream miles with benthic Index of Biotic Integrity (IBI) scores < 3.0 for the MBSS PSUs sampled in 2002

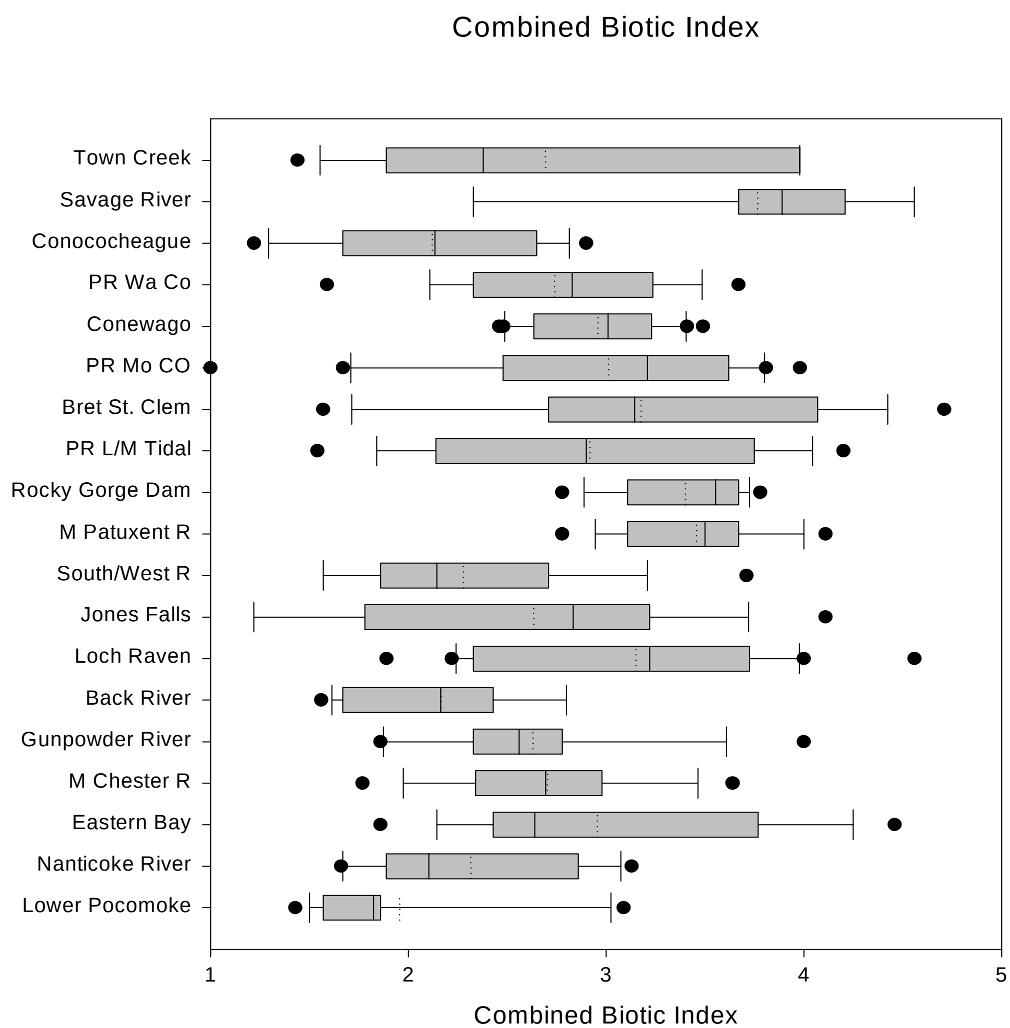


Figure 3-7. Distribution of the Combined Biotic Index (CBI) for the MBSS PSUs sampled in 2002

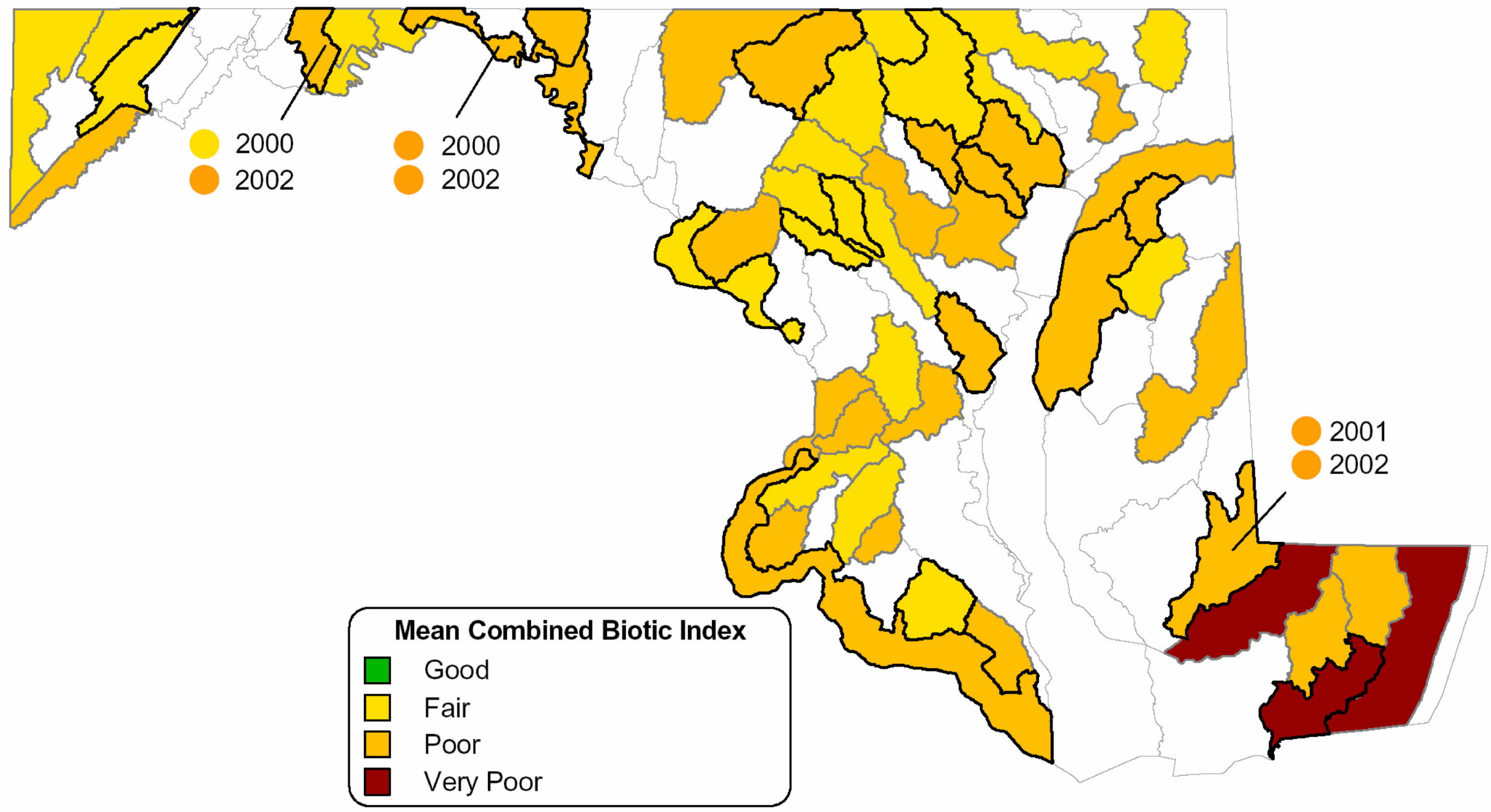


Figure 3-8. Mean Combined Biotic Index (CBI) in MBSS PSUs sampled in 2000, 2001, and 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

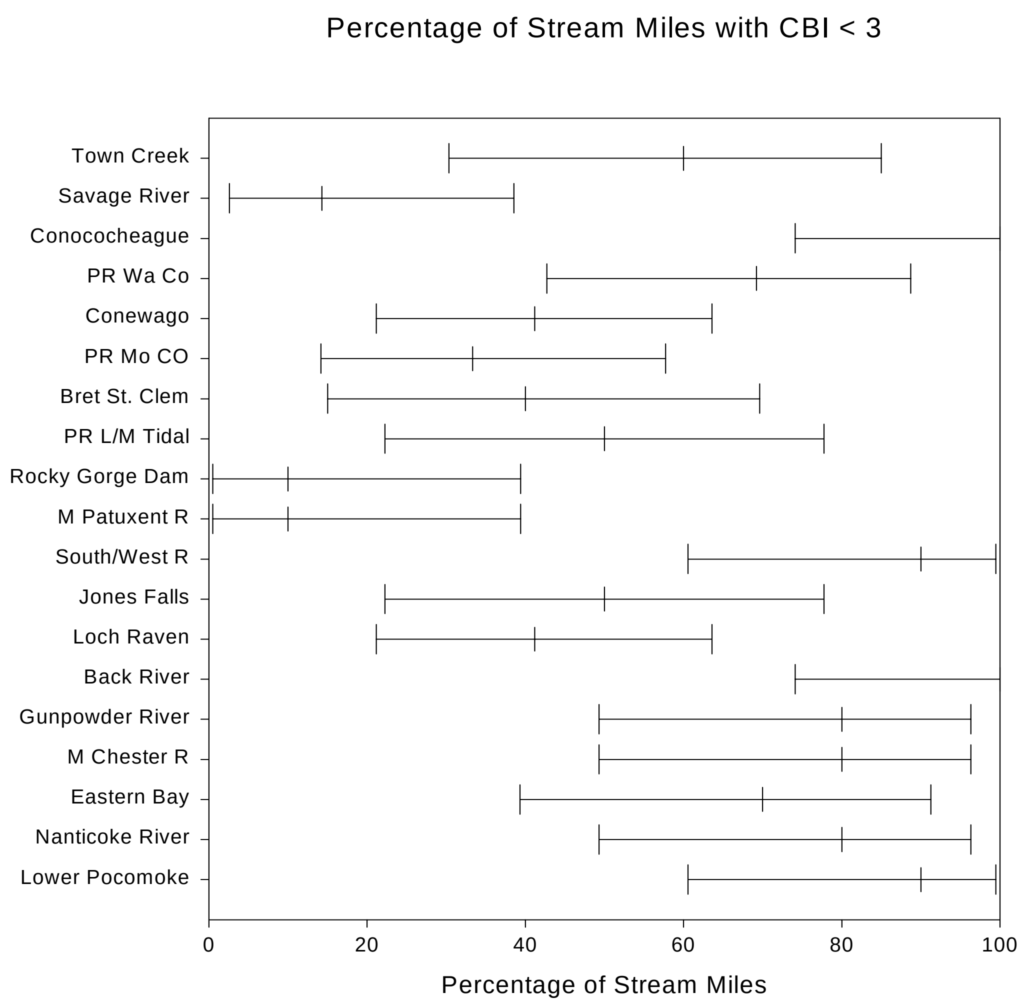


Figure 3-9. Percentage of stream miles with Combined Biotic Index (CBI) scores < 3.0 for the MBSS PSUs sampled in 2002

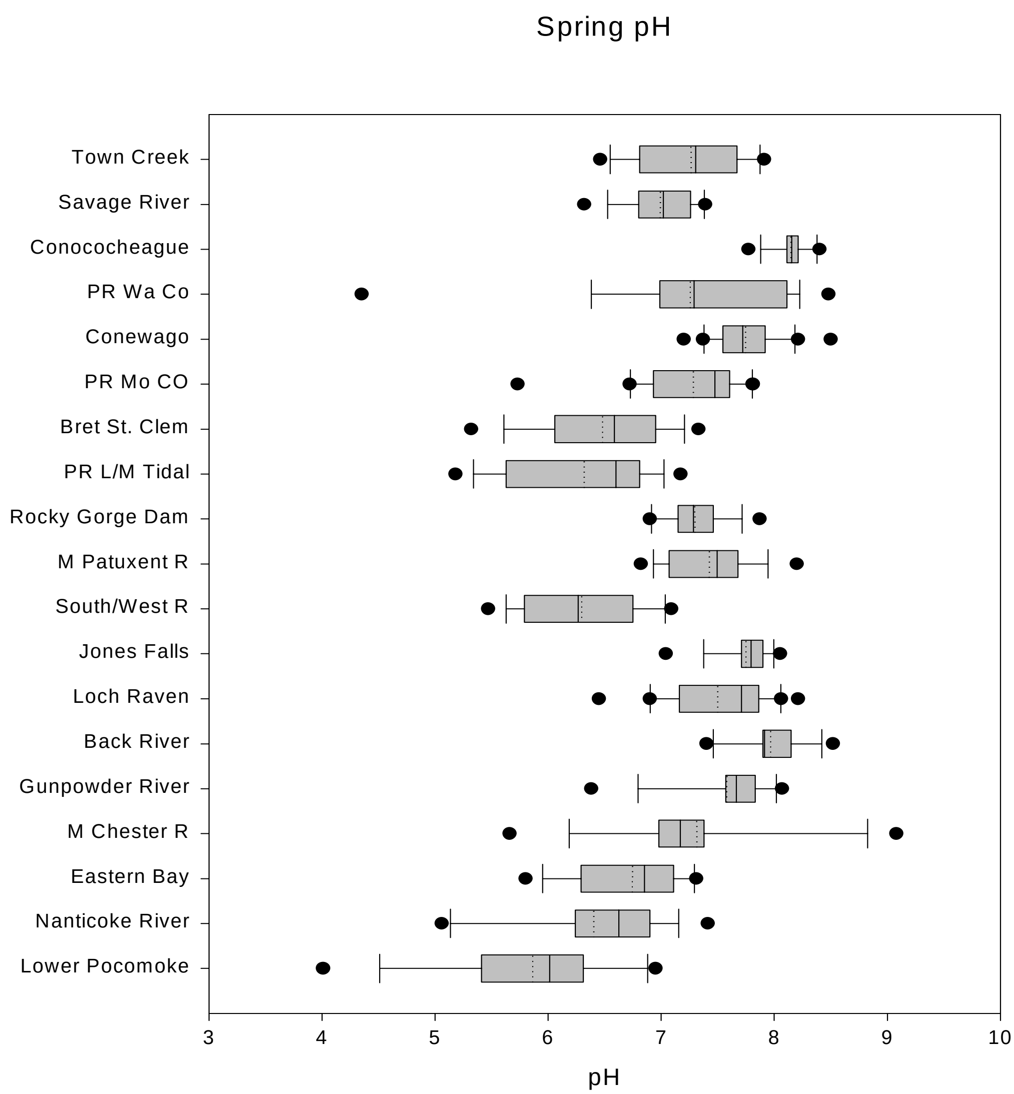


Figure 3-10. Distribution of spring pH values for the MBSS PSUs sampled in 2002

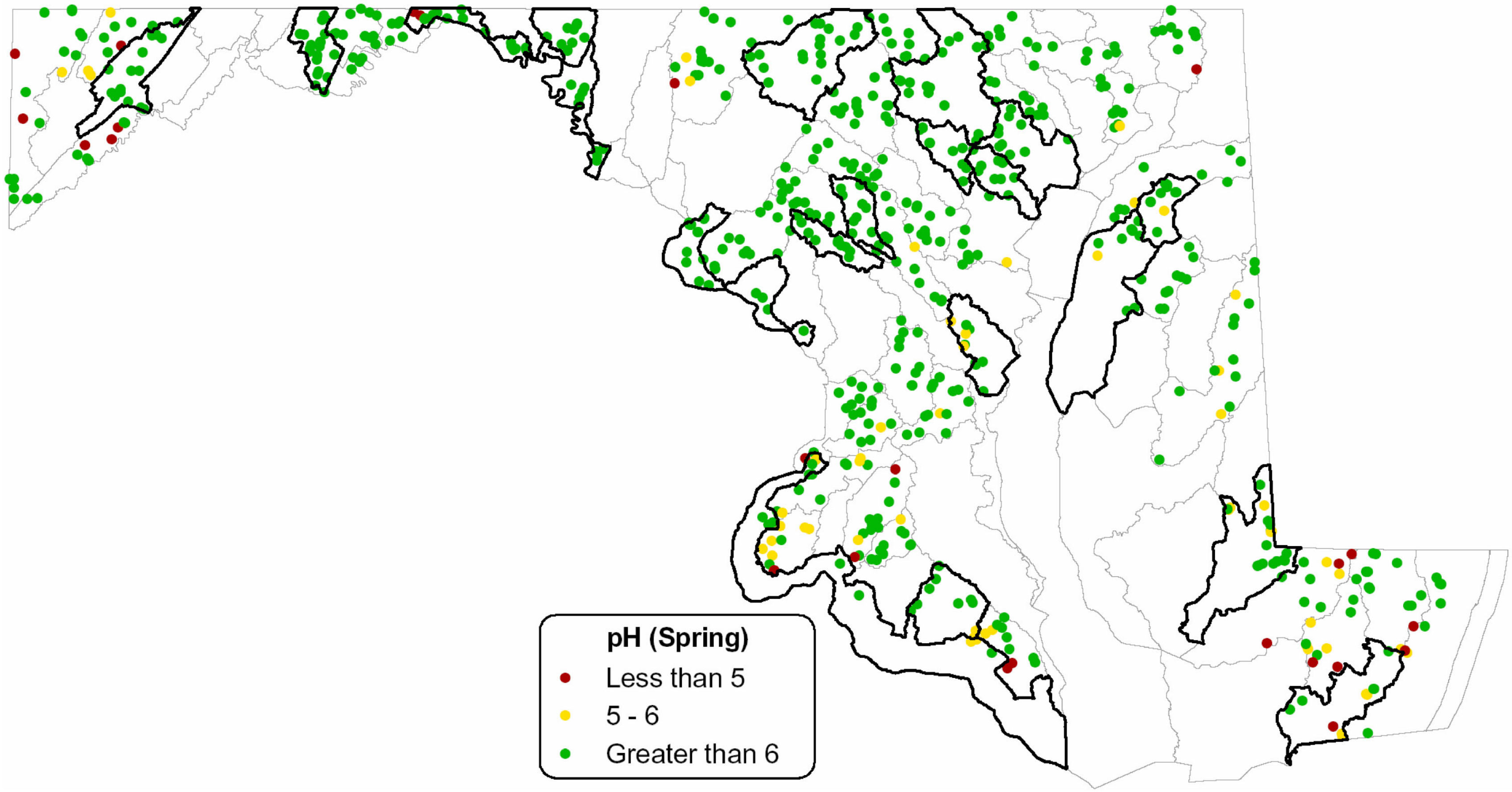


Figure 3-11. Distribution of spring pH values for sites sampled in the 2000, 2001, and 2002 MBSS. PSUs sampled in 2002 have bold outlines.

3.3.1 Low pH

During spring 2002 sampling, sites in two of 19 PSUs sampled exhibited pH < 5. Sites in nine PSUs had pH < 6. One PSU sampled had a mean pH < 6 during spring sampling - Lower Pocomoke. Spring pH values by PSU are shown in Figure 3-10. Spring pH values of individual sites are depicted in Figure 3-11. Typically, spring pH values are slightly lower than summer because of episodic acidification from spring rain events. As expected, pH tended to be slightly higher in most PSUs during the summer.

Results were used to estimate the extent of low spring pH conditions within each PSU as the percentage of stream miles with pH < 6 (Figure 3-12; Appendix Table B-7). For spring 2002, the greatest extent of low pH was estimated in Lower Pocomoke PSU, where the 90% confidence interval indicated that 22 to 78% of stream miles had pH < 6. Several other PSUs had slightly lower percentages of stream miles with pH < 6. Note that even in the 11 PSUs where no pH values < 6 were observed, the upper limit of the 90% confidence interval ranged from 18 to 26%, indicating the potential for low pH conditions to exist..

3.3.2 Low Acid Neutralizing Capacity

Although pH is the most commonly used measure of acidification, ANC is a better overall measure of acidification and acid sensitivity, because it also indicates which systems are likely to become acidified under episodic conditions. The following critical ANC values are used to characterize streams according to acid sensitivity: < 0 μeq/L (acidic), 0 < ANC < 50 μeq/L (highly sensitive to acidification), 50 < ANC < 200 μeq/L (sensitive to acidification), and > 200 μeq/L (not sensitive to acidification.

ANC values measured during spring 2002 are shown in Figures 3-13 and 3-14. Six PSUs, primarily thouse in Western Maryland and the Southern Coastal Plain, had sites with ANC < 50 μeq/L. As shown in Figure 3-15 (Appendix Table B-9), PSUs with the greatest estimate stream length with ANC < 50 μeq/L were Lower Pocomoke, Nanticoke, and Breton/St. Clements Bays. Estimtes of the percentage of stream miles with ANC < 200 μeq/L follow the geographic pattern noted in the MSSCS and Round One MBSS, with the greatest extent of acid-sensitive streams in Western Maryland and the Southern Coastal Plain (Figure 3-16, Appendix Table B-10).

3.3.3 Likely Sources of Acidity

In estimating the extent of acidification of Maryland streams, it is important to understand how acidic deposition, acid mine drainage (AMD), agricultural runoff, and natural organic materials contribute to the observed acidification. Acidic deposition is the contribution of material from atmospheric sources, both as precipitation (wet) and particulate (dry) deposition. Acidic deposition is generally associated with elevated concentrations of sulfate and nitrate in precipitation. AMD results from the oxidation of iron and sulfur from mine spills and abandoned mine shafts and is known to cause extreme acidification of surface waters.

Streams strongly impacted by AMD exhibit high levels of sulfate, manganese, iron, and conductivity. A third source of acidification is surface runoff from agricultural lands that are fertilized with high levels of nitrogen or other acidifying compounds. Lastly, the natural decay of organic materials may contribute to acidity in the form of organic anions, as in blackwater streams associated with bald cypress wetlands. Streams dominated by organic sources of acidity are often characterized by high concentrations of dissolved organic carbon and organic anions. Available water chemistry and land use data were used to screen for likely acidifying sources following the method employed in Round One analysis (Roth et al. 1999).

Results of the 2002 acid source screening indicate patterns that closely follow the results found in Round One of the Survey. A total of 42 sites (approximately 19%) sampled in 2002 had ANC < 200 μeq/L, an indication of acidification or acid sensitivity. A combination of organic ions and acidic deposition contributed to the acidification of one site in the Eastern Bay PSU and four sites in the Lower Pocomoke River. Agriculture contributed to the acidification of two sites in the Eastern Bay PSU and two sites in Savage River. In 2002, no sites showed acidification impacts contributed to by AMD. It should be noted, however, that permission denials and non-responses in the Savage River watershed may have influenced this result.

Acidic deposition effects were more widespread, affecting PSUs throughout the State, concentrating in the Southern Coastal Plain and Western Maryland. Thirty-three sites were affected in eight PSUs: Potomac River Washington County PSU (1 site), Nanticoke River (2 sites), Town Creek (2 sites), Lower Pocomoke (3 sites), Breton/St. Clements Bays (5 sites), Potomac River Lower Tidal/Potomac River Middle Tidal (6 sites), and Savage River (8 sites).

3.4 PHYSICAL HABITAT

Although many water resource programs tend to focus on water chemistry-based definitions of stream quality, physical habitat degradation can have an equal or greater effect on stream ecosystems and their biological communities. Habitat loss and degradation has been identified as one of the six critical factors affecting biological diversity in streams worldwide (Allan and Flecker 1993). Habitat degradation can result from a variety of human impacts occurring within the stream itself and in the surrounding riparian zone and watershed. Typical instream impacts include sedimentation, impoundment, and stream channelization. Urban development, timber harvesting, agriculture, livestock grazing, and the draining or filling of wetlands are well-known examples of human activities affecting streams at a broader scale. In watersheds impacted by anthropogenic stress, riparian (streamside) forests can ameliorate inputs of nutrients, sediments, and other pollutants to streams. They also provide other functions, such as shade, overhead cover, and inputs of leaf litter and large woody debris.

The Survey collects data to assess the extent and type of physical habitat degradation occurring in Maryland streams. A provisional Physical Habitat Indicator (PHI), developed during Round One of the MBSS, was used to assess the overall status of physical habitat conditions. In addition, examination of individual parameters are useful for assessing geomorphic processes, integrity of riparian vegetation, and alterations to natural temperature regime. Data from 2002 MBSS sampling were analyzed to examine key physical habitat parameters that may affect biological communities.

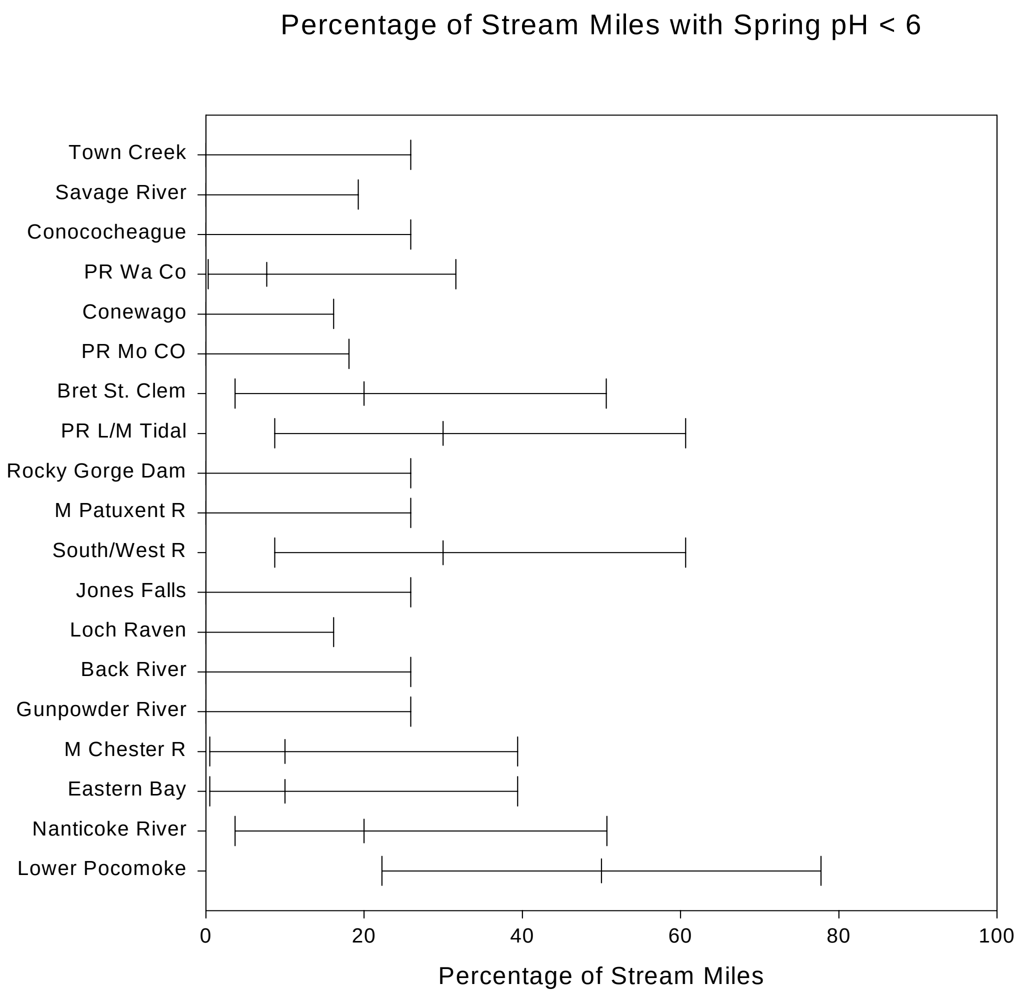


Figure 3-12. Percentage of stream miles with spring pH < 6.0 for the MBSS PSUs sampled in 2002

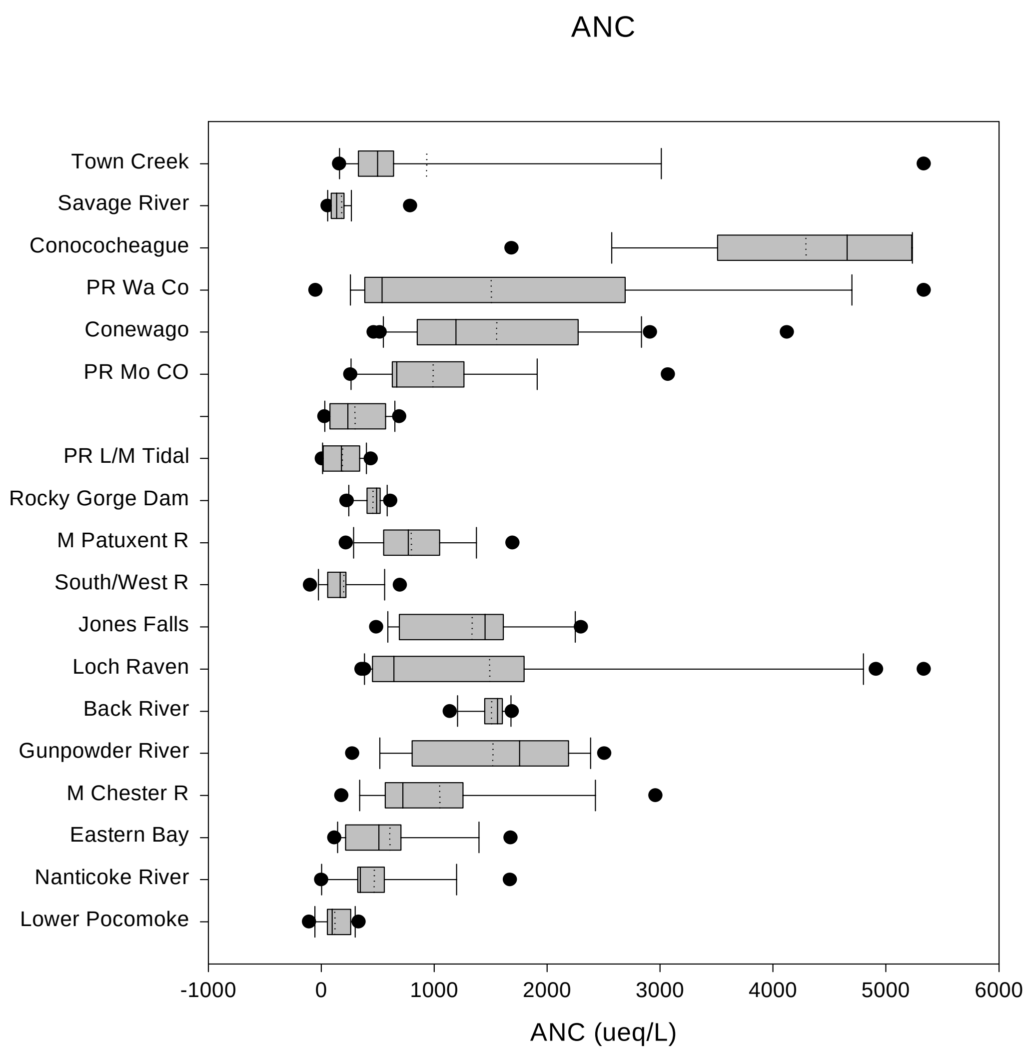


Figure 3-13. Distribution of Acid Neutralizing Capacity (ANC) values in μeq/L for the MBSS PSUs sampled in 2002

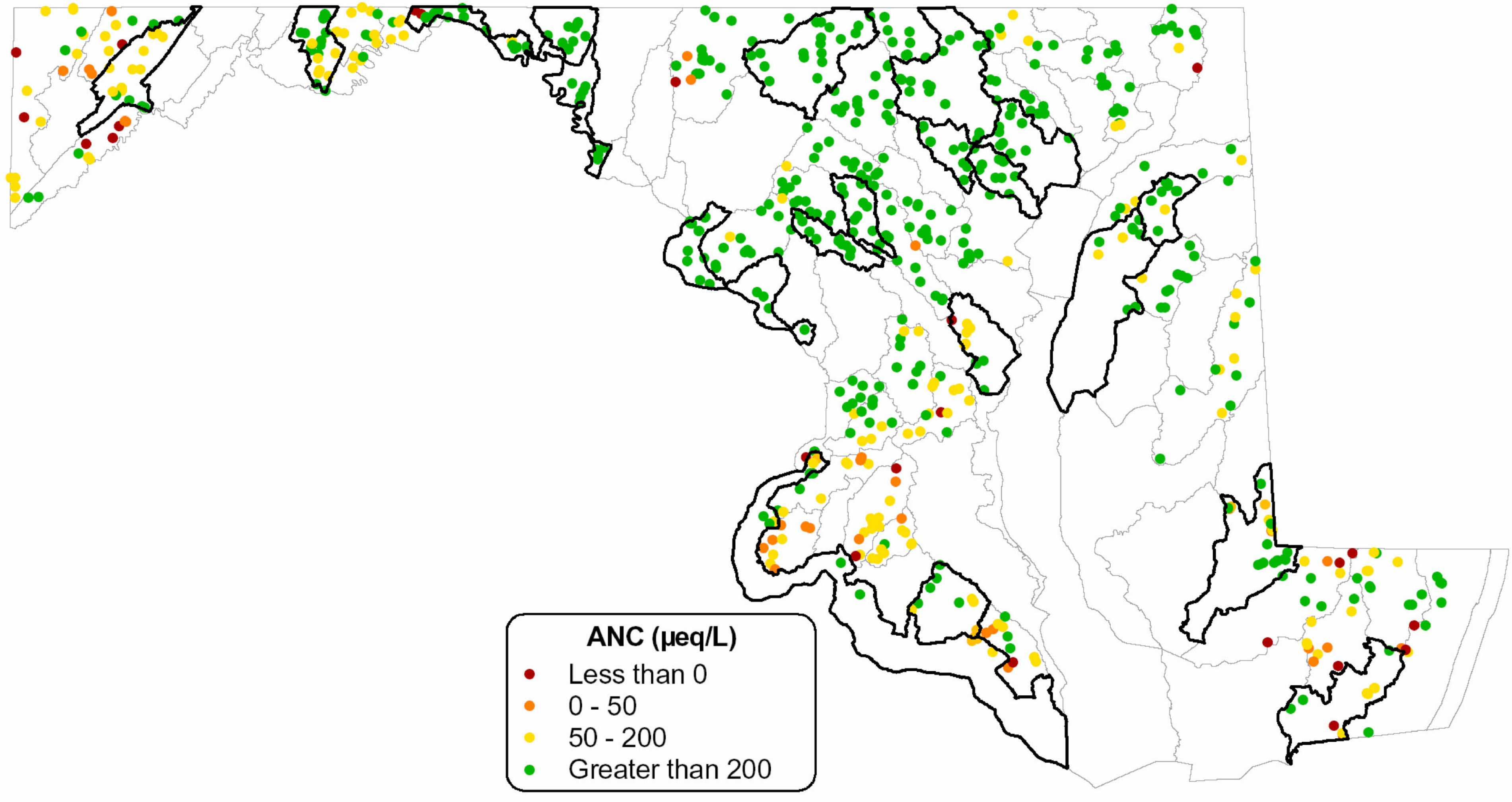


Figure 3-14. Distribution of Acid Neutralizing Capacity (ANC) values for the sites sampled in the 2000, 2001, and 2002 MBSS. PSUs sampled in 2002 have bold outlines.

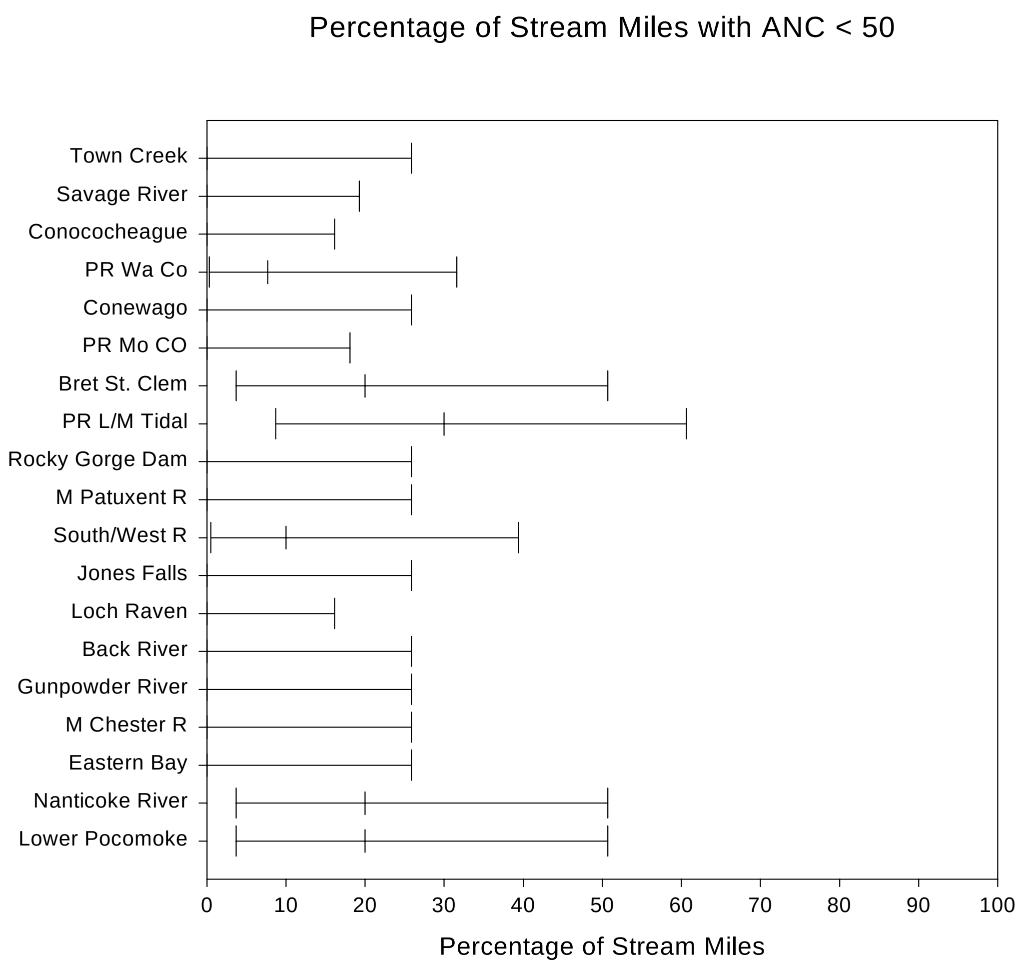


Figure 3-15. Percentage of stream miles with Acid Neutralizing Capacity (ANC) < 50 μeq/L for the MBSS PSUs sampled in 2002

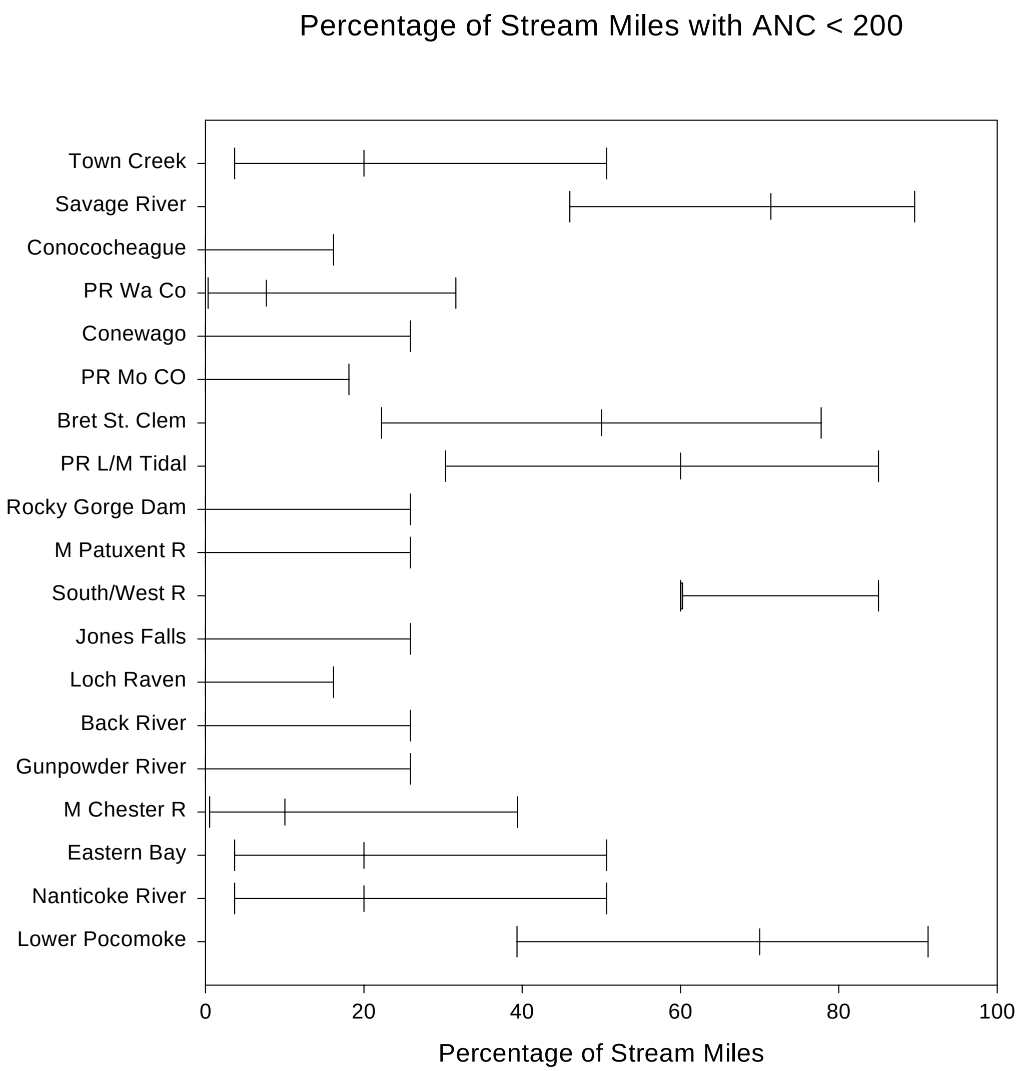


Figure 3-16. Percentage of stream miles with Acid Neutralizing Capacity (ANC) < 200 μeq/L for the MBSS PSUs sampled in 2002

3.4.1 Physical Habitat Index

A provisional PHI, developed using earlier MBSS data (Hall et al, 1999), was used to score sites sampled in 2002. Because of underlying differences in stream types, separate PHIs are applied on each of two geographic strata: the
Coastal Plain and the non-Coastal Plain. Four key physical habitat variables are common to both the Coastal Plain and non-Coastal Plain indices: (1) instream habitat structure, (2) velocity/depth diversity, (3) embeddedness, and (4) aesthetic rating (trash rating). Two additional variables are important in the Coastal Plain - pool/glide/eddy quality and maximum depth. Two other variables are included in the non-Coastal Plain - riffle/run quality and number of rootwads in a stream reach.

Index scores are adjusted to a centile scale that rates each sample segment as follows:

- Scores of 72 to 100 are rated good
- Scores of 42 to 71.9 are rated fair
- Scores of 12 to 41.9 are rated poor
- Scores of 0 to 11.9 are rated very poor

Scores for MBSS 2002 sampling were computed by comparison with the same distributions of metric values that were used to develop the PHI. Thus, indicator scores may be interpreted using the same narrative ratings employed in Round One.

Provisional PHI results by PSU are shown in Figure 3-17 and Appendix Table B-11. Scores varied widely within and among PSUs. Rocky Gorge Dam was the only PSU where the mean PHI was good (75.77). Mean PHI was poor in the Back River (17.71) and fair in the remaining 17 PSUs. The geographic distribution of mean PHI scores is shown on a statewide map (Figure 3-18).

Stream mile estimates of the occurrence of poor to very poor PHI scores suggest that physical habitat degradation is widespread (Figure 3-19, Appendix Table B-12). The greatest extent of low PHI scores was in the Back River, where the 90% confidence interval predicted that from 74 to 100% of stream miles were in poor and very poor condition. This PSU is an urban PSU (73% urban land upstream catchments) containing portions of Baltimore County and Baltimore City.

Statewide, 38% (standard error 0.03) of stream miles were rated Good for PHI, 24% (standard error 0.02) were rated Fair, 21% (standard error 0.02) were rated poor, 10% (standard error 0.01) were rated Very Poor and 7% (standard error 0.01) were Not Rated.

The reader should note that an improved physical habitat indicator has been developed for the MBSS (Paul et al. 2003). This revised index will be used at the end of Round Two to recalculate scores for all sites sampled in 2000-2004.

3.4.2 Geomorphic Processes

Channelization can substantially alter the character of the stream. Historically, streams were commonly channelized to drain fields and to provide flood control. Today, streams in urban areas are often channelized to accommodate road-building or to drain stormwater from developed areas. When previously meandering streams are straightened, they may lose their natural connection to the floodplain, with significant adverse consequences for the stream ecosystem. For example, increased flows during storm events can lead to greater scouring, greater bank instability, and disruption of the natural pattern of riffle and pool habitats. At other times, decreased baseflows can result in stagnant ditches with substrates degraded by heavy sediment deposition.

MBSS 2002 results indicate that stream channelization is common in some Maryland watersheds, particularly in the Coastal Plain (Figure 3-20, Appendix Table B-13). The most widespread incidence of channelization was observed in Nanticoke River (90% confidence interval; 49-96% of stream miles channelized) and Lower Pocomoke River (39-91% stream miles channelized).

Bank erosion is a common symptom of stream problems. Erosion within the stream channel, often associated with “flashy” flow regimes in highly urbanized watersheds, can scour banks and mobilize sediment. In fact, much of the sediment transported and deposited within the stream often sediment transported and deposited within the stream often originates from in-channel erosion rather than overland flow. Bank erosion is a sign of channel instability (side-cutting) when a stream becomes entrenched (i.e., can not react its floodplain during high flow events). While the lack of streambank vegetation can contribute to bank erosion, severe erosion can in turn destabilize vegetation, causing even large tress to fall.

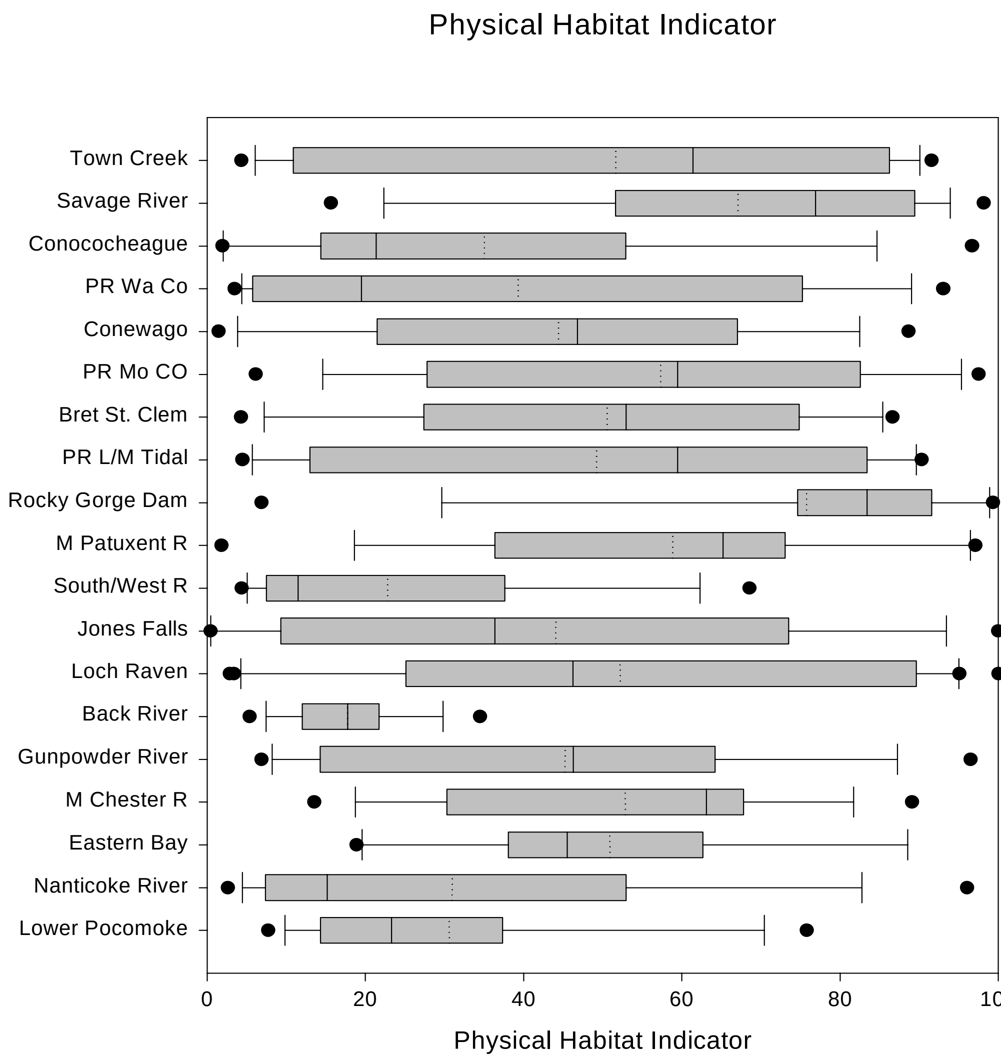


Figure 3-17. Distribution of Physical Habitat Indicator (PHI) scores for the MBSS PSUs sampled in 2002

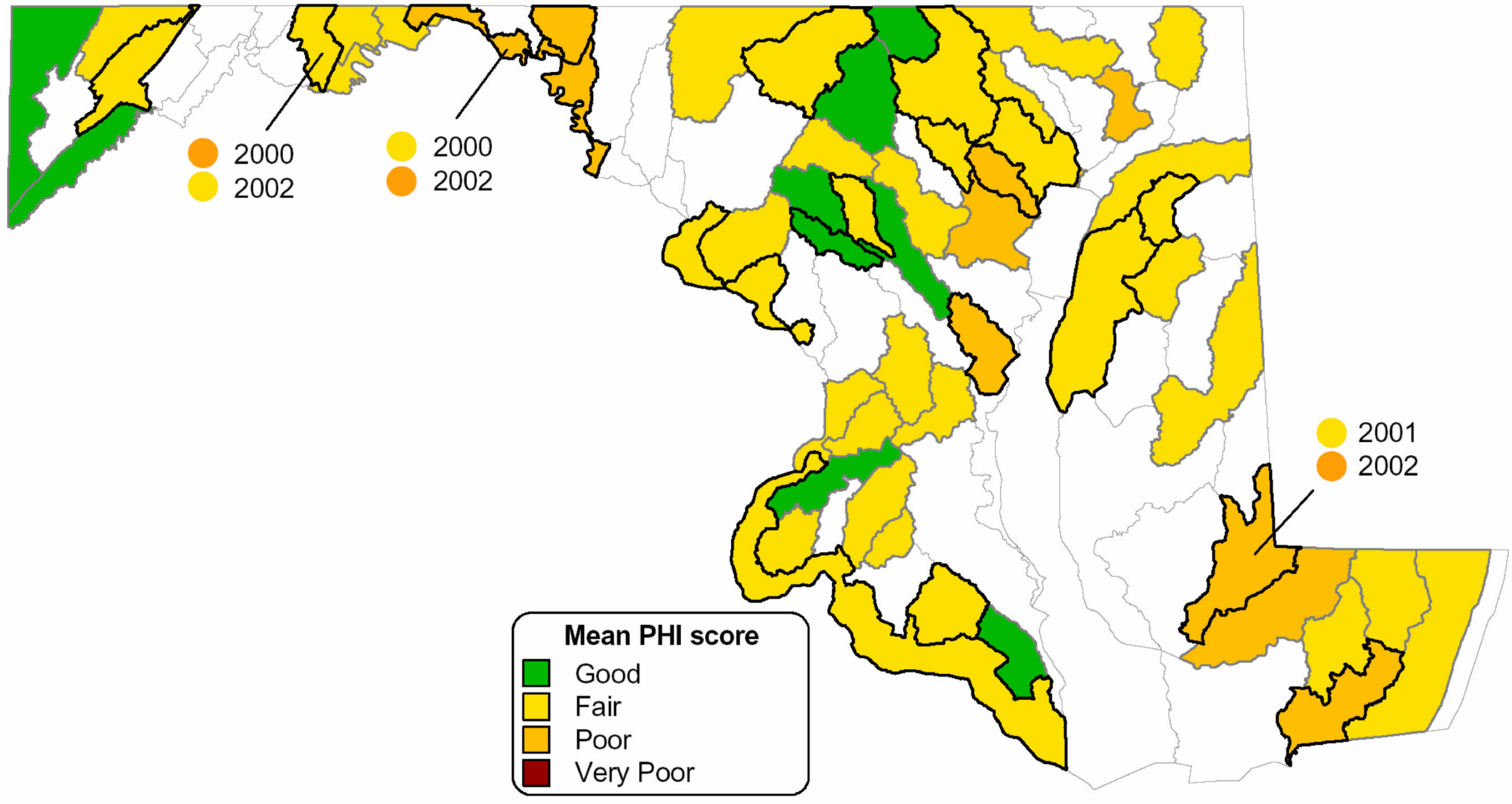


Figure 3-18. Mean Physical Habitat Indicator (PHI) scores for the MBSS PSUs sampled in 2000, 2001, and 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

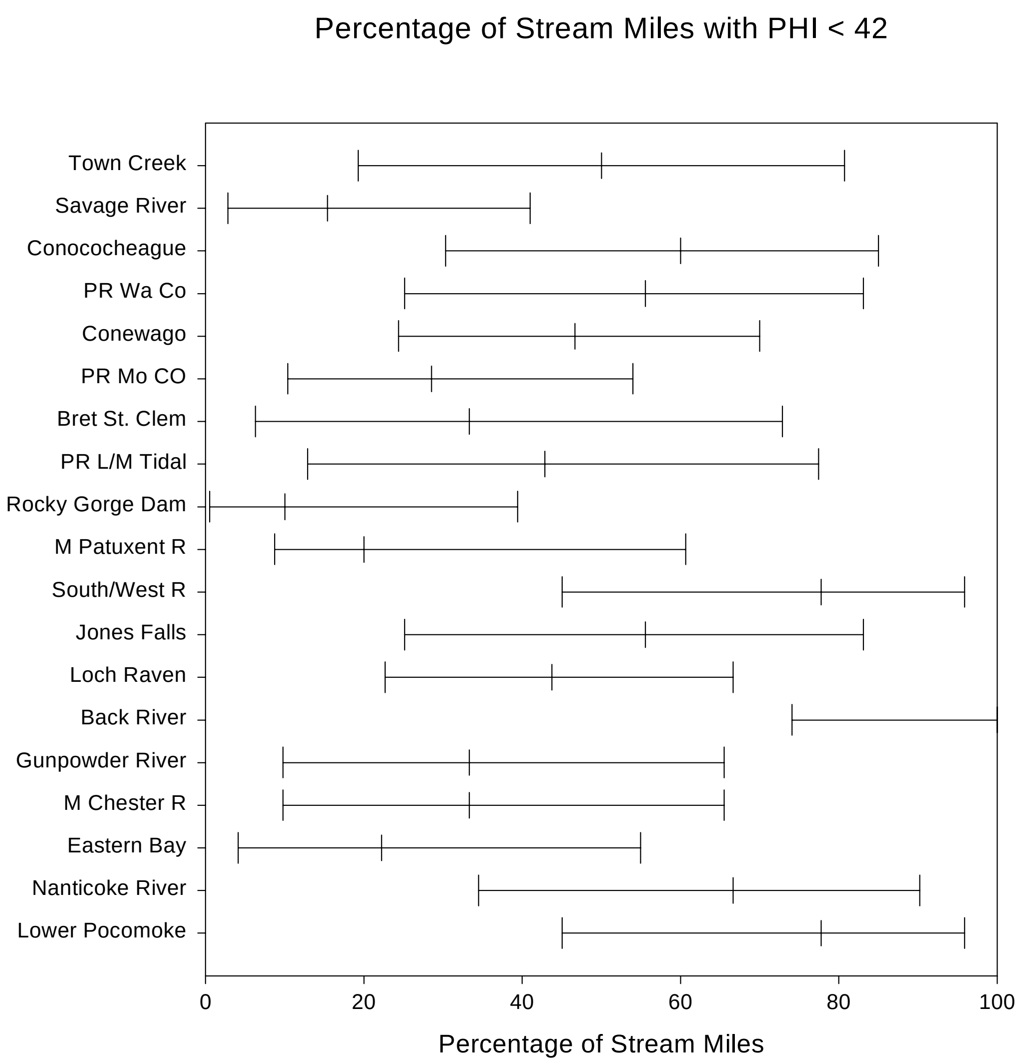


Figure 3-19. Percentage of stream miles with Physical Habitat Indicator (PHI) < 42 (poor to very poor) for the MBSS PSUs sampled in 2002

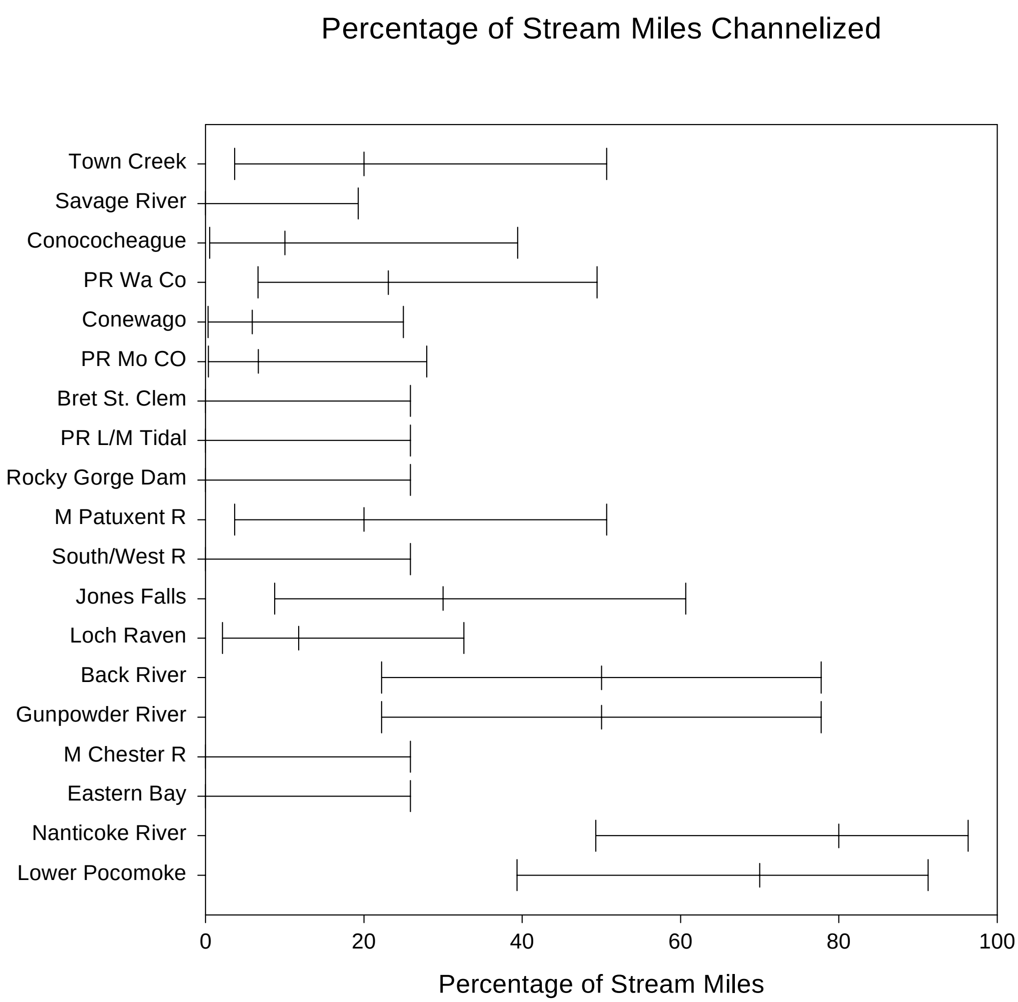


Figure 3-20. Percentage of stream miles channelized for the MBSS PSUs sampled in 2002

Moderate to severe bank erosion occurs commonly in Maryland streams, as seen in MBSS 2002 sampling results (Figure 3-21, Appendix Table B-14). Many watersheds had a high occurrence of bank erosion. The greatest extent of moderate to severe bank erosion was estimated for Rocky Gorge Dam (90% confidence interval; 74 to 100% of stream miles).

Within each 75-meter segment sampled, field estimates of the amount of eroded bank area were made. Moderate to severe erosion was included in this analysis. Mean values by PSU were used to estimate the extent of eroded area (square meters) per stream mile. The highest values were in Potomac River Lower Tidal/Potomac River Middle Tidal, Breton/St. Clements Bays, Rocky Gorge Dam, and Loch Raven Reservoir. Per-mile areas were then used to project the total surface area of bare, eroded bank in each PSU (Table 3-3). Combined the eroded bank area in these 19 PSUs totals more than 610.

Significant deposition of gravel and fine sediments can lead to bar formation. Although some formation of bars is natural, more severe bar formation can signal channel instability related to bank erosion and altered flow regimes. In streams without other forms of stable habitat such as rootwads and large woody debris, biotic communities often show signs of impairment event. In addition, sediments eroded from banks can become resuspended, increasing turbidity and deposition in downstream areas.

Exacerbated bar formation was observed in all watersheds sampled in 2002 (Figure 3-22, Appendix Table B-15). Estimates of the percentage of stream miles experiencing moderate to severe bar formation were highest in Back River (90% confidence interval; 74 to 100% of stream miles) and Breton/St. Clements Bays (42 to 99% of stream miles).

3.4.3 Vegetated Riparian Buffers and Woody Debris

A complete characterization of stream habitat goes beyond in-channel measures and includes the riparian zone adjacent to the stream. The effectiveness of the riparian buffer in mitigating nutrient loading and providing other benefits to the stream varies with the type and amount of riparian vegetation. MBSS records data on both the type and extent of local riparian vegetation, estimated as the functional width of the riparian buffer along each side of the 75-meter segment.

Table 3-3. Eroded streambank area (in m^2) by stream miles and total eroded streambank area per PSU sampled in MBSS 2002

Watershed	Mean Eroded Area per 75m^2	Mean Eroded Area per Mile	Number of Stream Miles in PSU	Acreage of Eroded Area
Back River	61	1309.0	43.4	14.2
Breton/St. Clements Bays	106	2274.7	112.7	64.1
Conewago Creek/Double Pipe Creek	60	1287.6	252.1	81.1
Conococheague	23	493.6	66.5	8.2
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	57	1223.2	29.4	9.0
Gunpowder River/Lower Gunpowder Falls/Bird River/ Middle River-Browns	89	1909.9	84.4	40.3
Jones Falls	91	1952.8	60.3	29.5
Loch Raven Reservoir	101	2167.4	241.8	131.0
Lower Pocomoke	14	300.4	71.0	5.3
Middle Chester River	31	665.2	45.0	7.5
Middle Patuxent River	81	1738.2	76.3	33.2
Nanticoke River	2	42.9	72.0	0.8
Potomac River Lower Tidal/Potomac River Middle Tidal	119	2553.6	70.2	44.8
Potomac River Montgomery County	58	1244.6	152.5	47.5
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway	26	557.9	102.9	14.3
Rocky Gorge Dam	105	2253.2	55.1	31.0
Savage River	12	257.5	132.4	8.5
South River/West River	64	1373.4	62.6	21.5
Town Creek	28	600.9	125.4	18.8

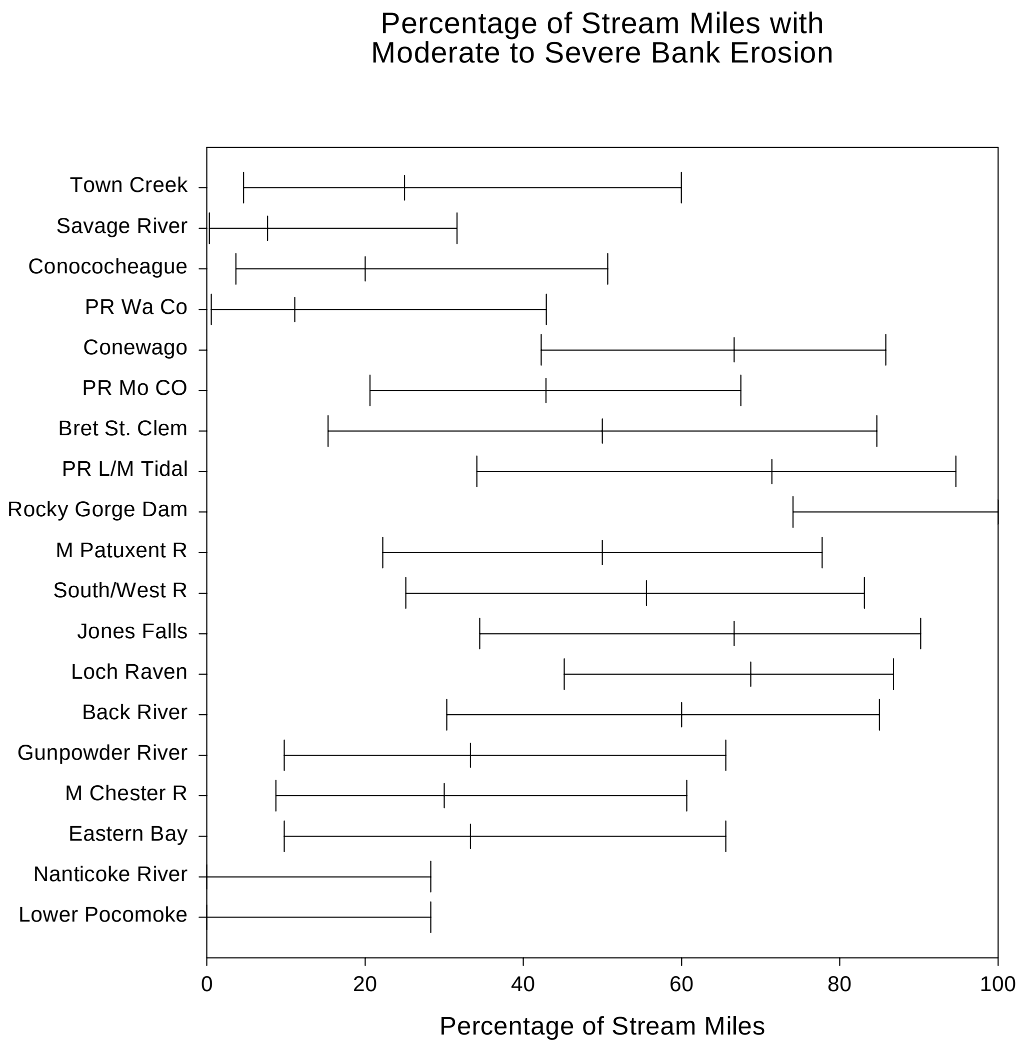


Figure 3-21. Percentage of stream miles with moderate to severe bank erosion for the MBSS PSUs sampled in 2002

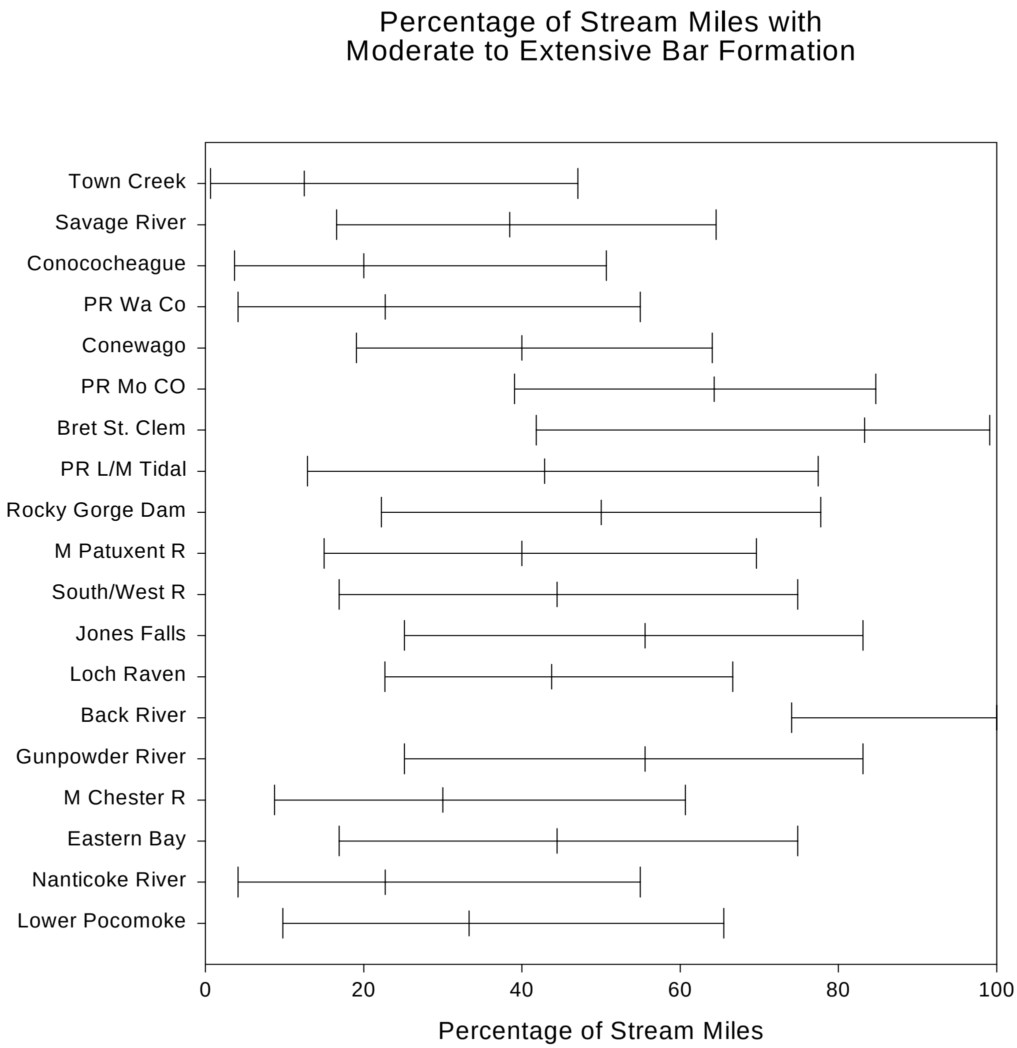


Figure 3-22. Percentage of stream miles with moderate to extensive bar formation for the MBSS PSUs sampled in 2002

Lack of riparian vegetation on at least one stream bank was observed within 13 of the 19 PSUs sampled. Data were used to estimate the percentage of stream miles lacking riparian buffer vegetation on at least one bank (Figure 3-23) or on both banks (Figure 3-24, Appendix Tables B-16 and B-17).

The presence of non-native plant species is another indication of the integrity of the riparian plant community. Invasive species such as multiflora rose, mile-a-minute, and Japanese honeysuckle can crowd out native plants. Several watersheds appeared affected by the presence of non-native plants (Figure 3-25, Appendix Table B-18). In cases of high abundance along streams, these species can prevent natural regeneration and/or growth of intentionally planted trees and are thus a threat to buffer reestablishment.

Rootwads and other types of woody debris provide habitat, cover, and shade for a variety of stream biota. When riparian forests are removed, this important source of woody debris is lost. To assess the availability of this key habitat feature, the numbers of rootwads and other woody debris within each 75-meter segment were recorded by MBSS field crews. The total number of instream pieces of woody debris and rootwads was relatively consistent throughout the 19 PSUs sampled (Figure 3-26, Appendix Table B-19), although sites with substantially higher amounts were located in both the Jones Falls and Loch Raven Reservoir PSUs. Along with wood found within the wetted width of the stream itself, other in-channel (but dewatered) woody debris is a potential future source of habitat. Separate results for instream, dewatered, and total counts of woody debris and rootwads are shown in Figures 3-27 to 3-32 (Appendix Tables B-20 to B-25). The amount of rootwads and large woody debris in Maryland streams is expected to grow over time as forestry professionals further recognize the critical role that wood plays in stream health.

3.4.4 Temperature

During 2002, MBSS deployed continuous reading temperature loggers at more than 200 sites. The long-term goal is to use temperature data to (1) better classify and characterize coldwater streams and (2) identify streams stressed by temperature changes, such as spikes from rapid inputs of warm water running off impervious surfaces during summer storms. Data were recorded at 20-minute intervals with loggers set to record the highest value observed during each 20 minute interval. Initial data analyses consisted of a quality assurance review (to exclude sites where temperature loggers were lost or not submerged in the stream during low flow periods), establishment of a consistent period of record, and computation o f several summary indicators. Indicators were calculated for 229 sites where the data record was complete. Generally, the period of record considered was June 1 to August 15.

Summary indicators included:

1. Mean average daily temperature
2. Mean minimum and maximum daily temperatures
3. Absolute maximum temperature
4. 95th percentile temperature
5. Percentage of readings exceeding thresholds in state water quality standards

Maryland water quality standards for temperature state that the maximum temperature may not exceed 32 °C (90 °F) in most waters, 20 °C (68 °F) in Class III Natural Trout Waters, or 23.9 °C (75 °F) in Class IV Recreational Trout Waters (COMAR 1995).

Results for sites monitored in 2002 are listed in Appendix C. Among all sites assessed, mean average daily temperatures ranged from 13.6 to 27.9 °C, indicating the presence of both coldwater and warmwater sites in the data set. The lowest mean daily minimum was 12.1 °C at a fourth-order site in Loch Raven Reservoir. Future analyses of data from coldwater streams will assist in interpretation of IBI scores and will contribute to development of a fish IBI tailored to these systems. Trout and several non-game species require cool to cold waters. For example, EPA criteria for growth and survival of brook trout (Maryland's only native salmonid) are maximum weekly means of 19 and 24 °C. Research has found a still lower temperature of 14.4 °C as the maximum temperature for juvenile growth of brook trout (EPA 1976 and McCormick et al. 1972, as cited in Eaton et al. 1995).

Six sites that were not labeled as dry in the summer had more than 10% of their readings greater than 32 °C. Two sites in Jones Falls had temperatures exceeding 32 °C more than 30% of the time. A systematic review of whether any Class III or IV streams exceeded standards would require examination of site data by stream class and was beyond the scope of this report.

Examples of daily temperature data from coldwater and warmwater sites are shown in Figures 3-33 and 3-34.

3.5 NUTRIENTS AND OTHER WATER CHEMISTRY

Nutrients such as nitrogen and phosphorus are important for life in all aquatic systems. In the absence of human influence, streams contain background levels of nutrients influence, streams contain background levels of nutrients that are essential to the survival of the aquatic plants and animals in that system. However, during the last several hundred years, the amount of nutrients transported to many stream systems has increased greatly as a result of anthropogenic influences such as agricultural runoff, wastewater discharge, urban/suburban nonpoint sources, and atmospheric deposition.

Excessive nitrogen and phosphorus loading may lead to eutrophication, particularly in downstream estuaries. Eutrophication often decreases the level of dissolved oxygen available to aquatic organisms. Prolonged exposure to low dissolved oxygen values can suffocate biota or lead to reduced conditions. Increased nutrient loads are also thought to be harmful to humans by causing toxic algal blooms and contributing to outbreaks of toxic organisms such as *Pfiesteria piscicida*. In Maryland, concern for nutrient loadings to the Chesapeake Bay has drawn attention to the amounts of materials transported from throughout the watershed by stream tributaries.

The Survey provides a large dataset that can be used to assess nutrient concentrations under spring baseflow conditions. Although a full understanding of nutrient loadings also requires data collected during storm runoff events and over time (i.e., taken over multiple years and seasons), the Survey's water chemistry results provide extensive spatial coverage and a useful picture of where nutrient levels are high.

In addition to various nitrogen and phosphorus measures, the Survey assesses dissolved oxygen (DO), turbidity, sulfate (as an indicator of AMD), chloride (an indicator of general anthropogenic disturbance), and dissolved organic carbon (DOC). Key results are summarized below. Where possible, results are compared with threshold levels likely to indicate human influence (Roth et al. 1999 and R. Morgan, personal communication, 2001). To illustrate the potential degree of human impact, many figures referenced below show data in relation to these thresholds, depicted in graphs by a vertical dotted line.

3.5.1 Nutrients

Total nitrogen concentrations tended to be highest on the Eastern Shore (Figures 3-35 and 3-36). In general, nitrate nitrogen (Figure 3-37) made up the largest fraction of total nitrogen. Nitrite nitrogen was higher in Central Maryland (specifically in the Conococheague PSU) and the Eastern Shore than elsewhere in Maryland (Figure 3-38). As expected, ammonia, often associated with agriculture, was highest in the Eastern Bay PSU and Conococheague, both highly agricultural watershed (Figure 3-39). Appendix Tables B-26 to B-29 detail these results by PSU.

Nitrate nitrogen concentrations greater than 1 mg/L are commonly considered to indicate anthropogenic influence. This is several times higher than the concentration of 0.08 mg/L recently reported for streams in undisturbed watersheds (Clark et al. 2000). Mean nitrate nitrogen concentrations in 15 of the 19 PSUs sampled in 2002 exceeded 1 mg/L. Estimates of the percentage of stream miles with nitrate nitrogen > 1 mg/L by PSU dramatically illustrate the extent of elevated nitrate levels, especially in Central Maryland (Figure 3-40, Appendix Table B-30). In several PSUs, 100% of stream miles have high nitrate nitrogen concentrations.

Total phosphorus tended to be substantially higher on the Eastern Shore, lower in Western Maryland, and moderate in the central part of the state (Figures 3-41 and 3-42). Results for orthophosphate share a similar pattern and are shown in Figure 3-43. Appendix Tables B-31 and B-32 detail these results by PSU.

3.5.2 Other Water Quality Parameters

Dissolved oxygen concentrations at most locations were greater than 5 mg/L, the COMAR standard and a level generally considered healthy for aquatic life (Figure 3-44, Appendix Table B-33). The only PSU with a mean DO < 5 mg/L was the Potomac River Lower Tidal/Potomac River Middle Tidal. Individual sites with low DO should be examined for natural causes such as low gradient, blackwater conditions that make the streams particularly susceptible to BOD loading from anthropogenic sources. Estimates of the percentage of stream miles with low DO are given in Figure 3-45 (Appendix Table B-34). Seasonal monitoring of streams suspected to have low DO problems and examination of watershed factors would help to diagnose situations where the problem is persistent and can be linked to anthropogenic causes.

As expected (because sampling generally is done when water clarity is good), turbidity was generally low (Figure 3_46, Appendix Table B-35). Conococheague and Loch Raven Reservoir each had one site with a turbidity value greater than 200 NTUs. A more complete characterization of turbidity in a given stream would require monitoring during storm events.

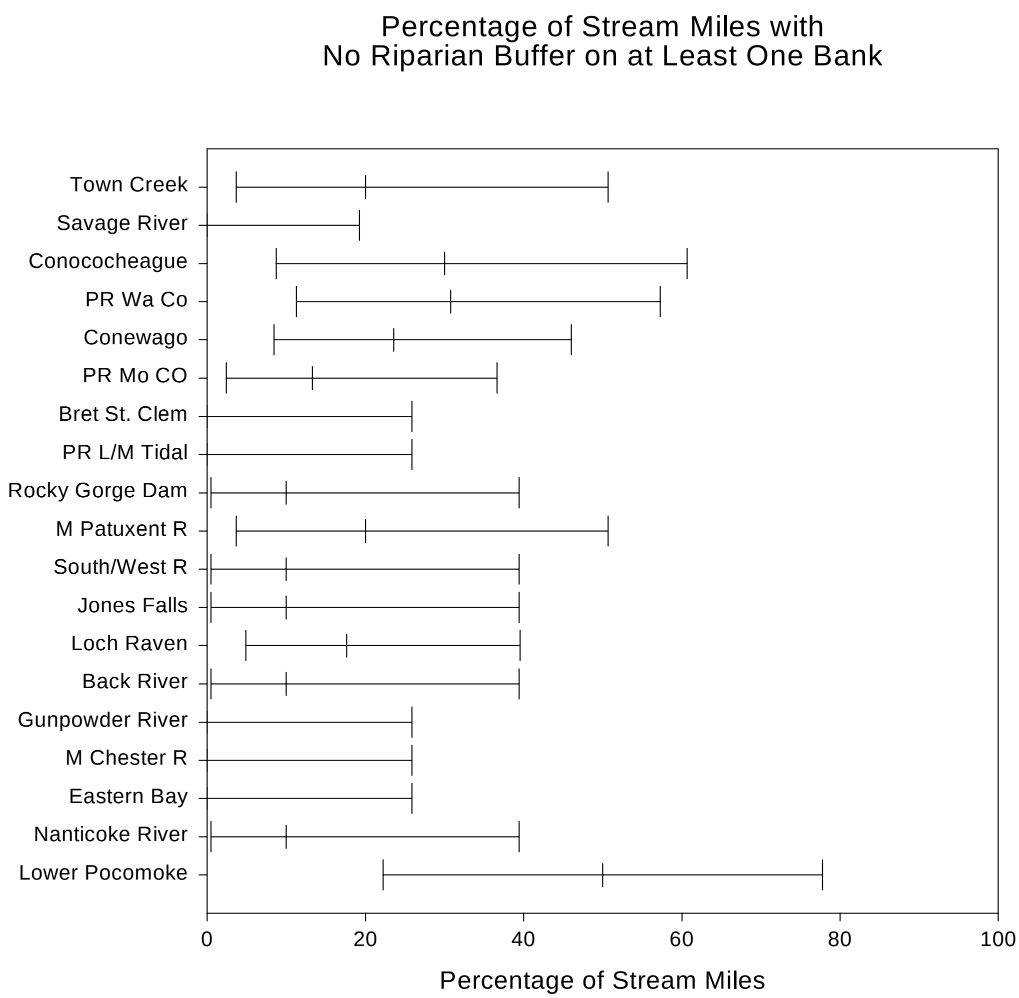


Figure 3-23. Percentage of stream miles with no riparian buffer on at least one bank for the MBSS PSUs sampled in 2002

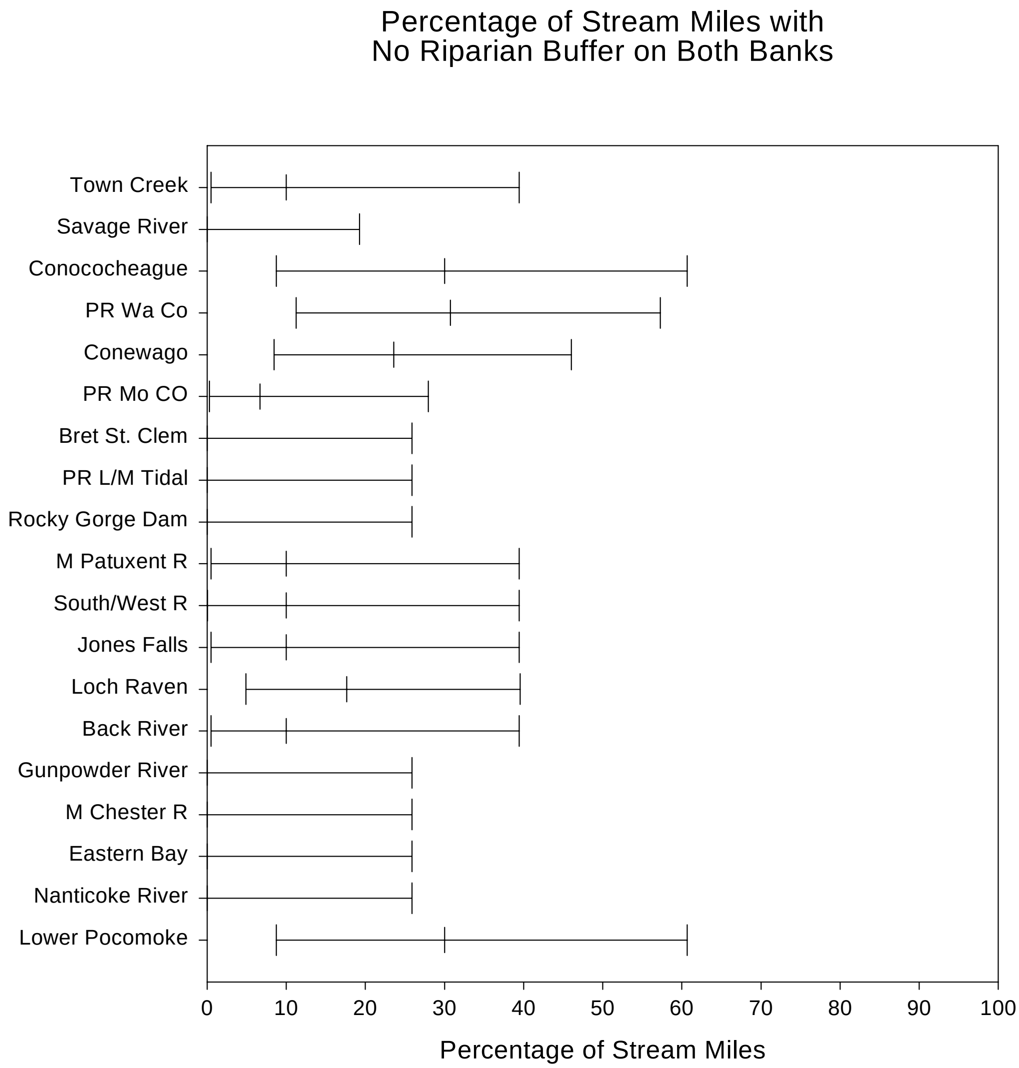


Figure 3-24. Percentage of stream miles with no riparian buffer on both banks for the MBSS PSUs sampled in 2002

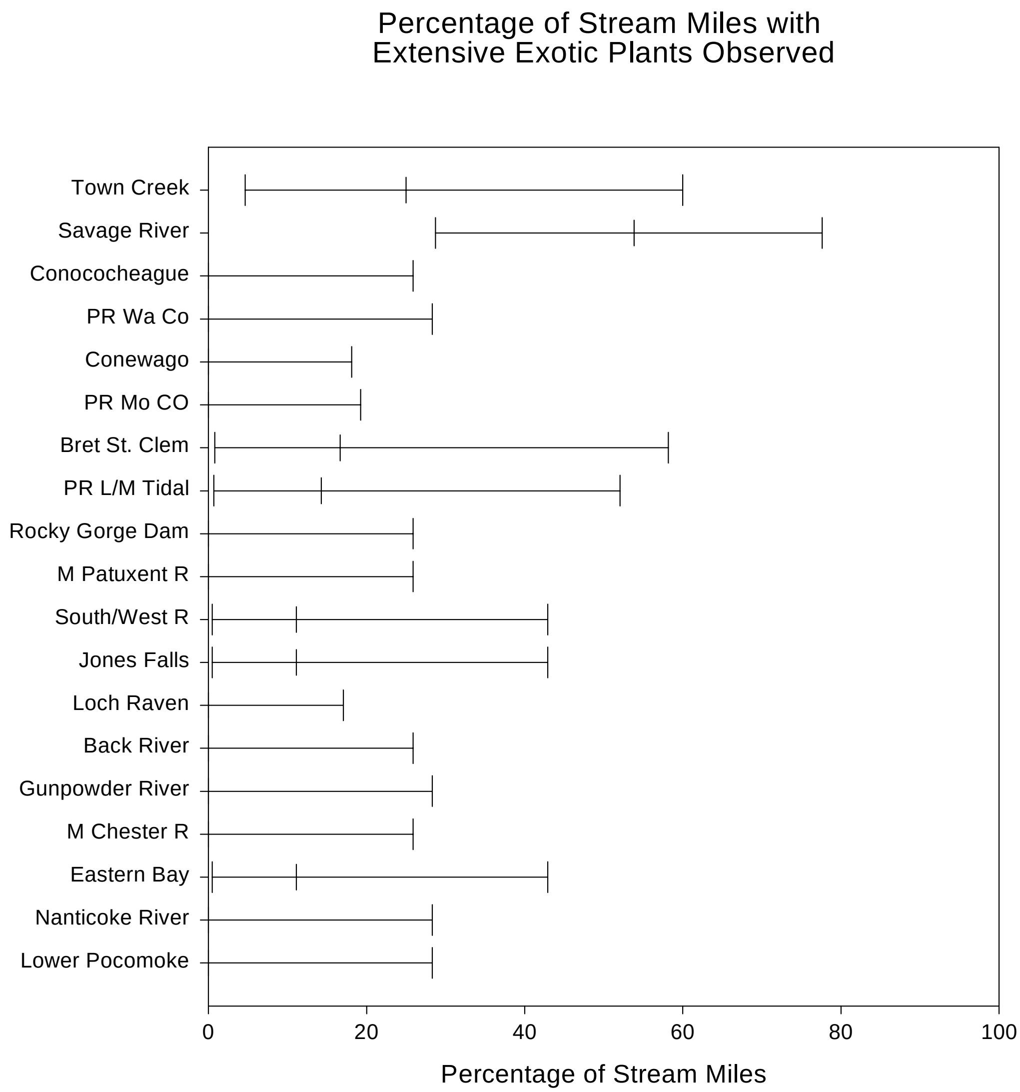


Figure 3-25. Percentage of stream miles with extensive amounts of exotic plants observed for the MBSS PSUs sampled in 2002

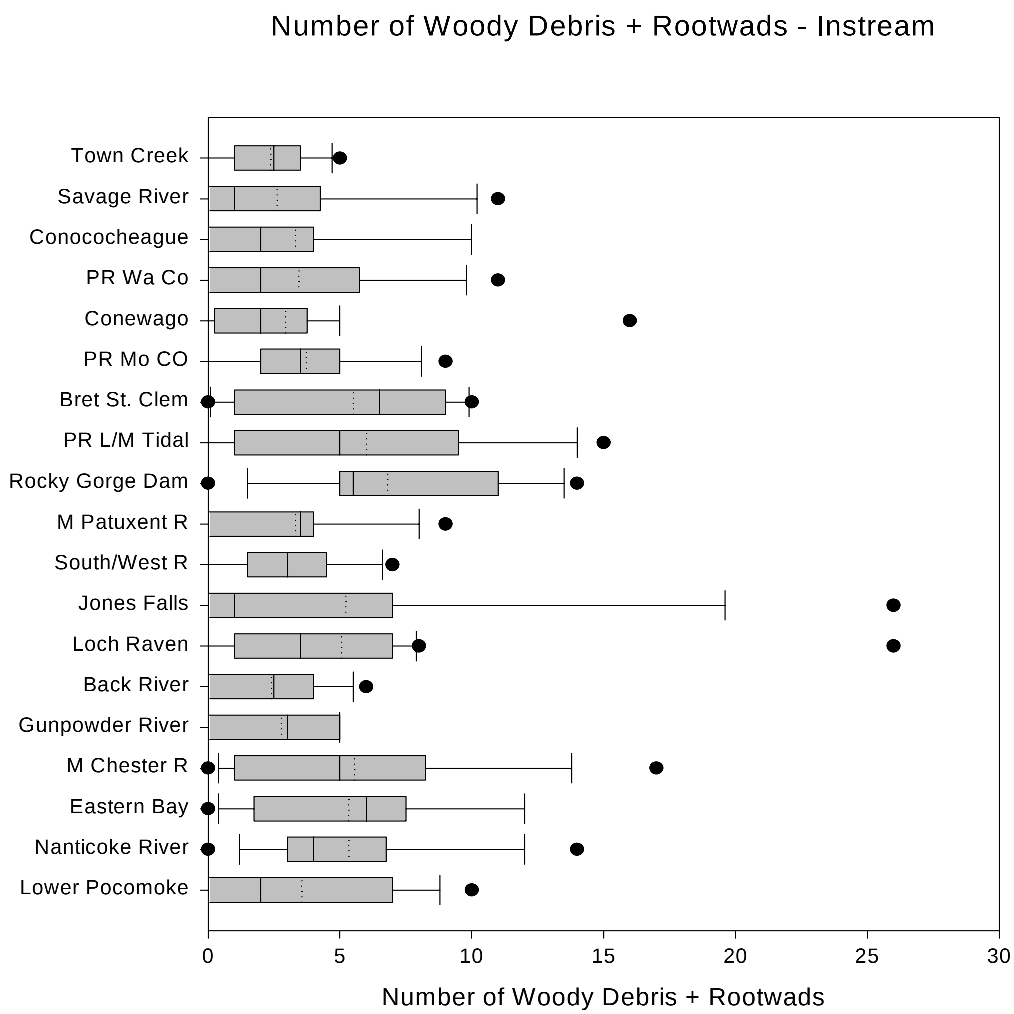


Figure 3-26. Distribution of the sum of the total number of instream woody debris and the total number of instream rootwads for the MBSS PSUs sampled in 2002

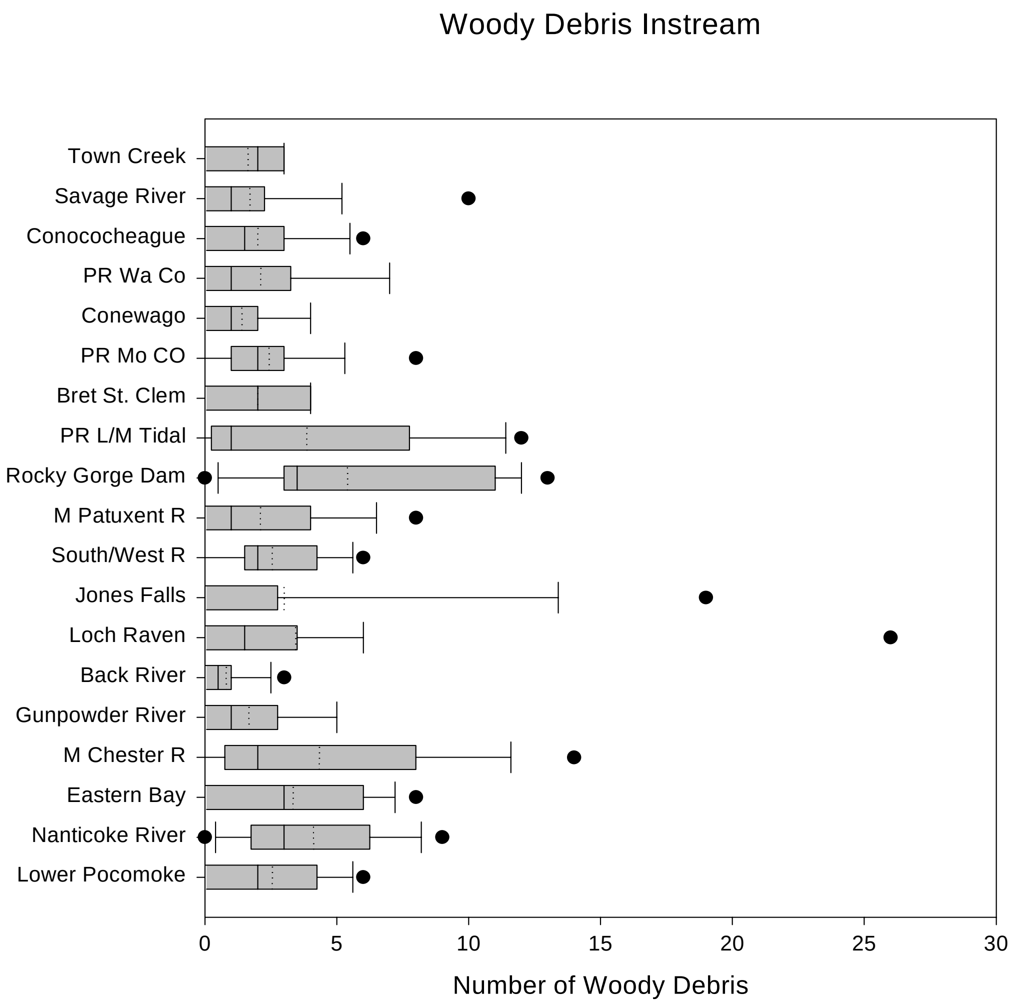


Figure 3-27. Distribution of the number of instream woody debris for the MBSS PSUs sampled in 2002

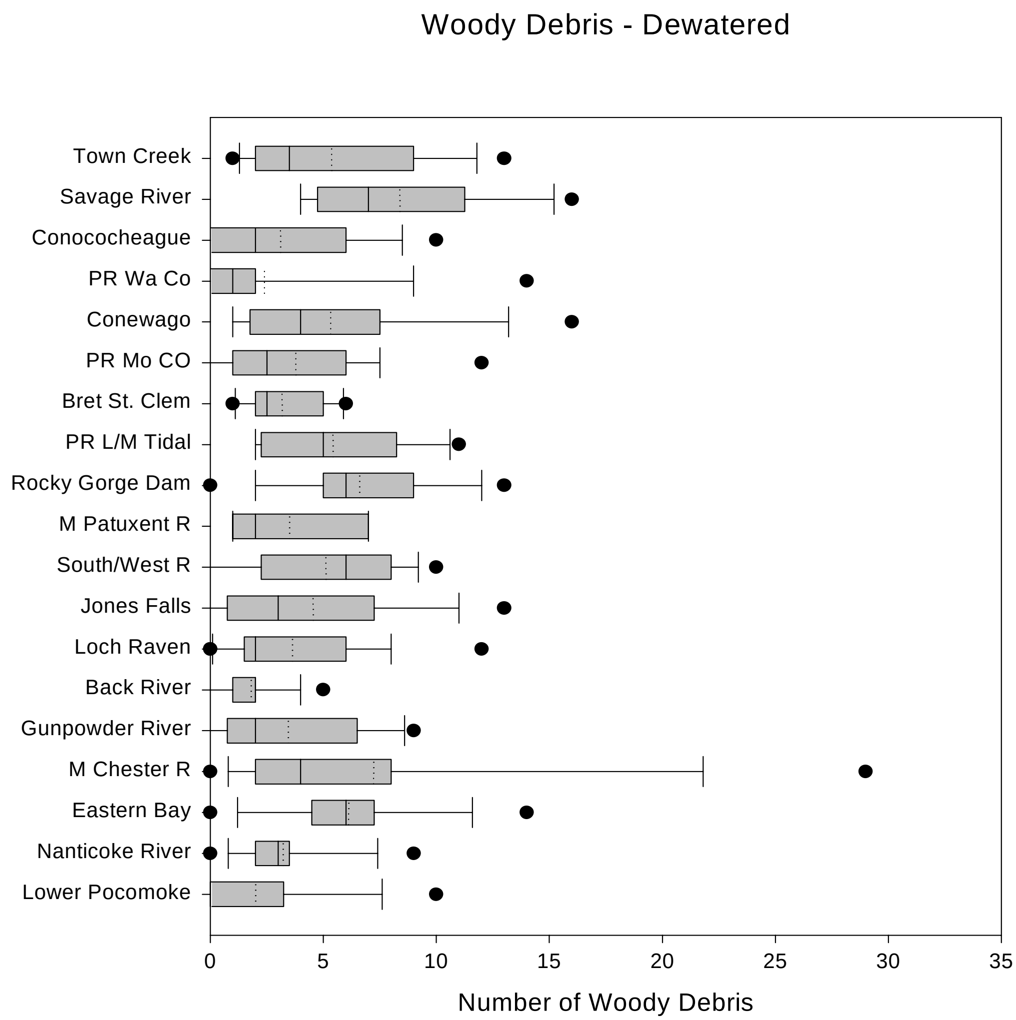


Figure 3-28. Distribution of the number of dewatered woody debris for the MBSS PSUs sampled in 2002

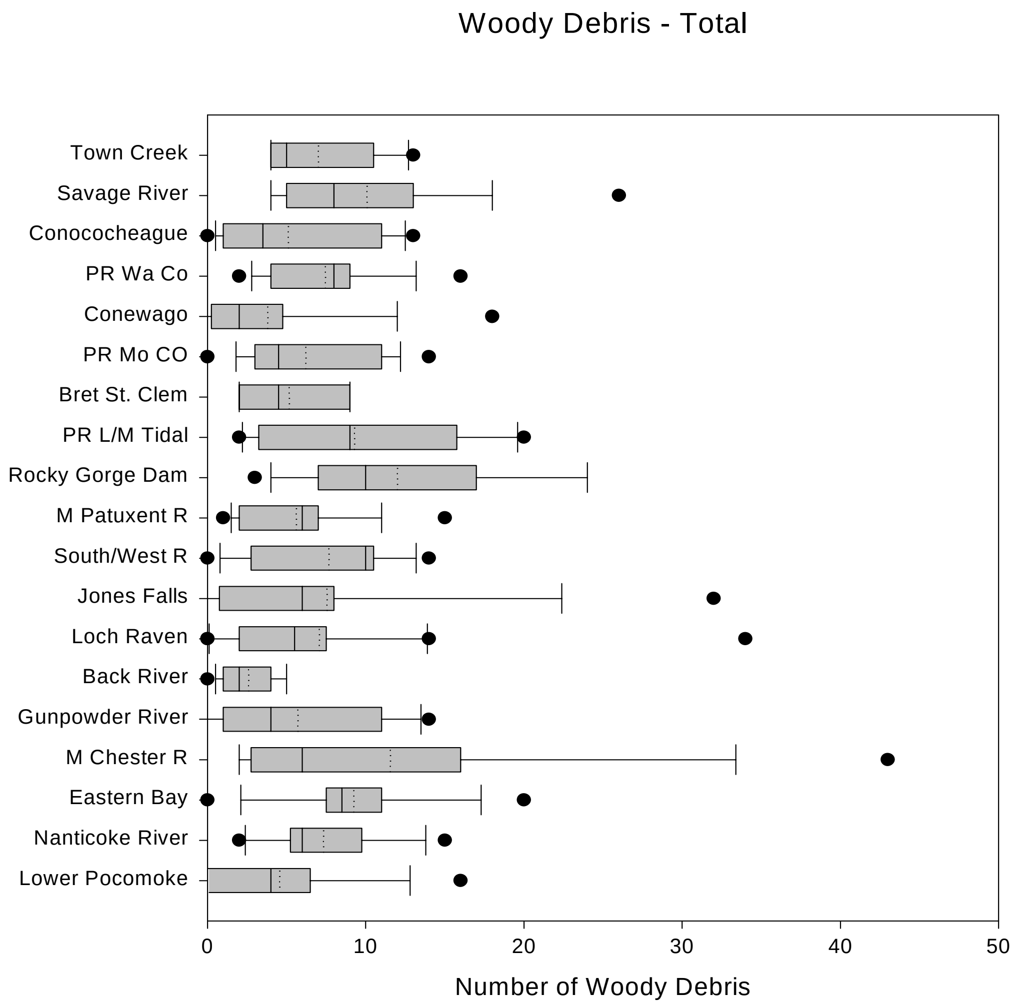


Figure 3-29. Distribution of the total number of woody debris (instream and dewatered) for the MBSS PSUs sampled in 2002

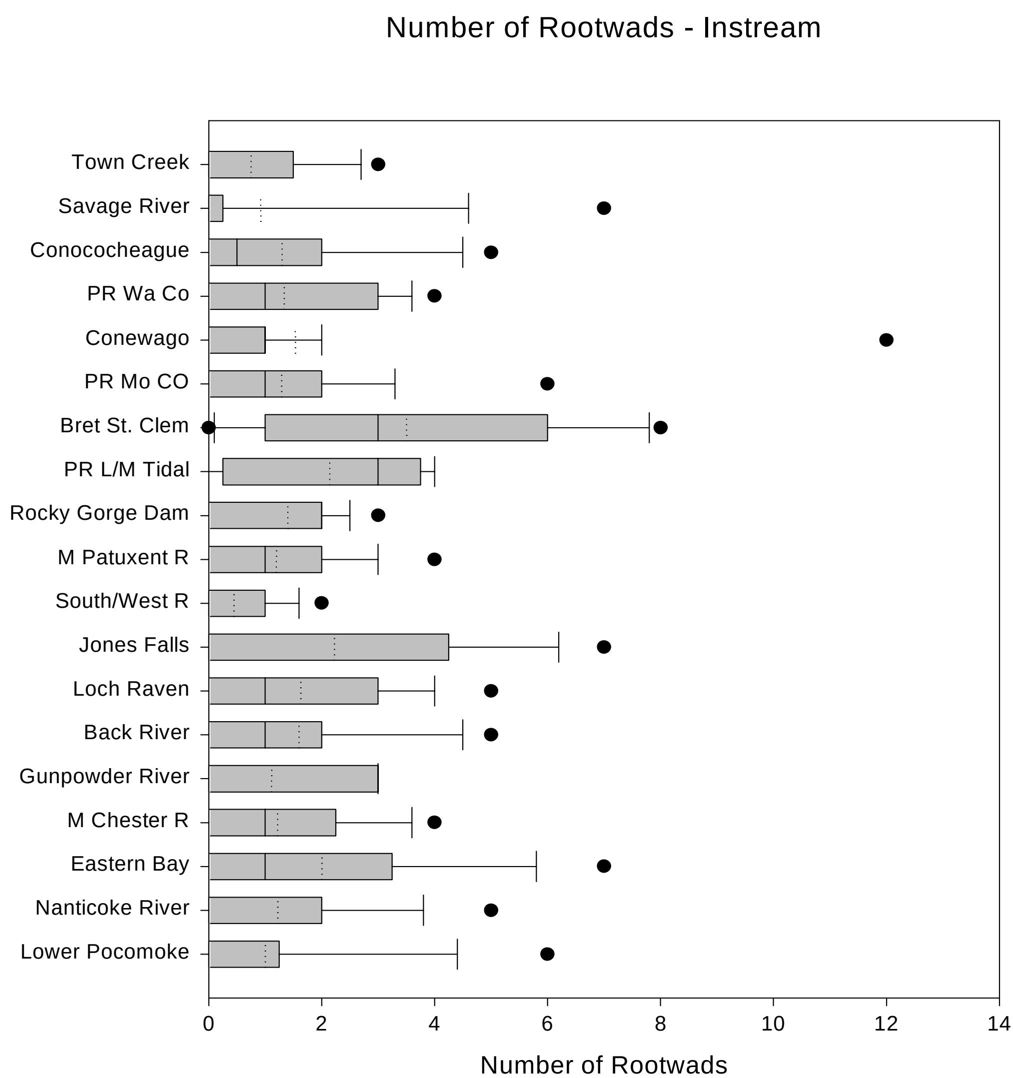


Figure 3-30. Distribution of the number of instream rootwads for the MBSS PSUs sampled in 2002

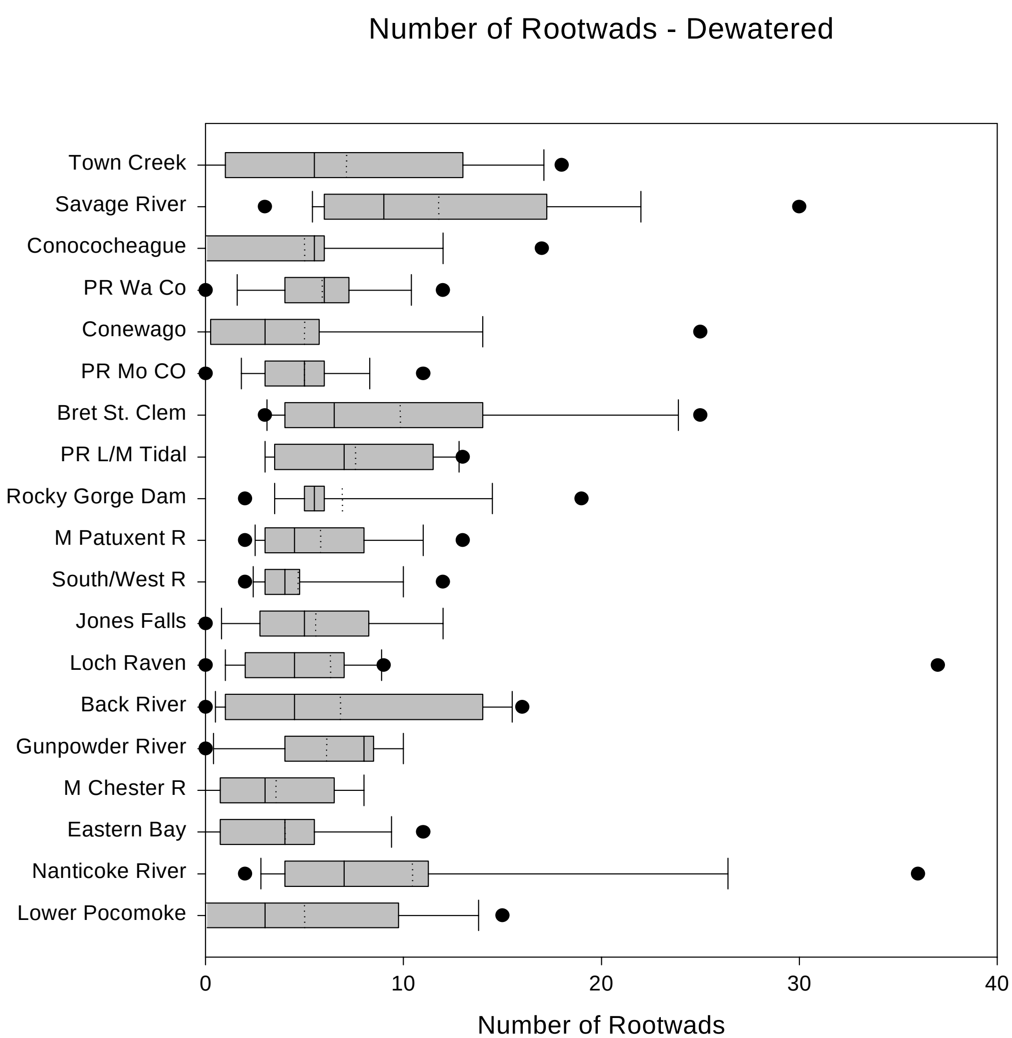


Figure 3-31. Distribution of the number of dewatered rootwads for the MBSS PSUs sampled in 2002

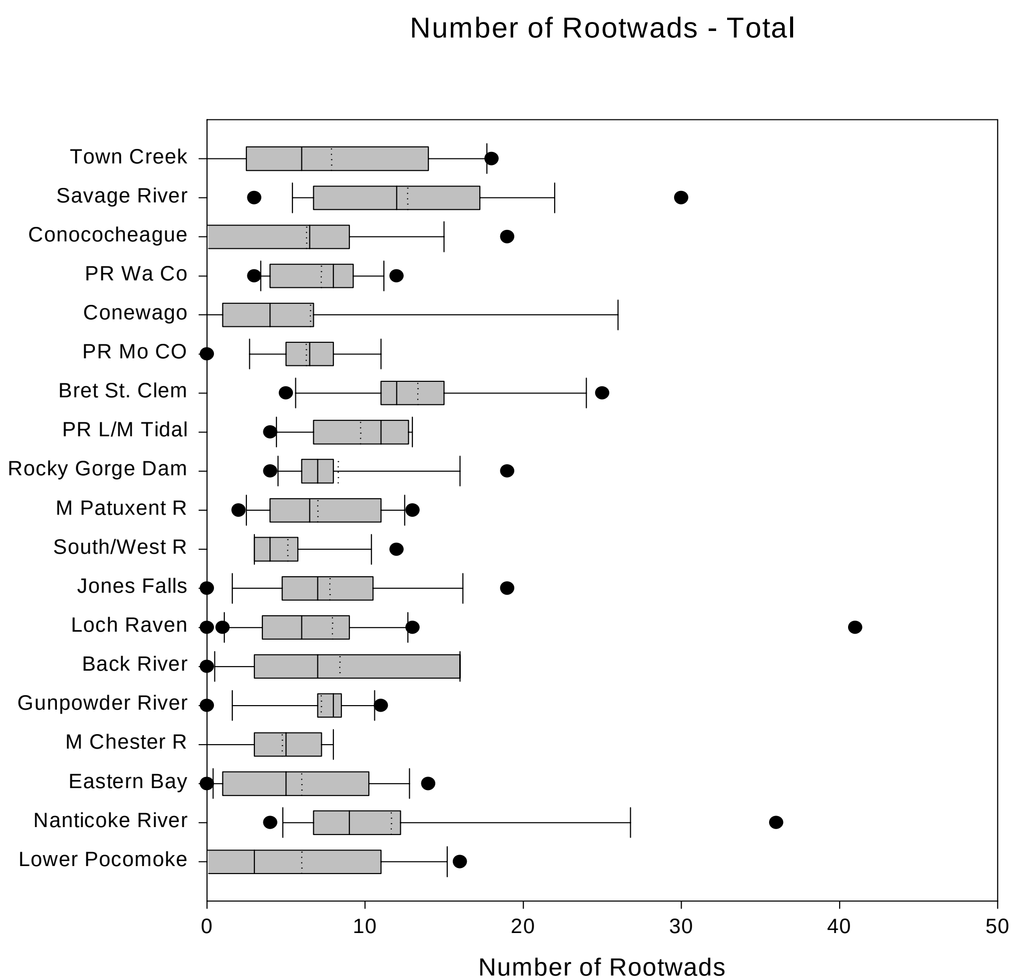


Figure 3-32. Distribution of the total number of rootwads (instream and dewatered) for the MBSS PSUs sampled in 2002

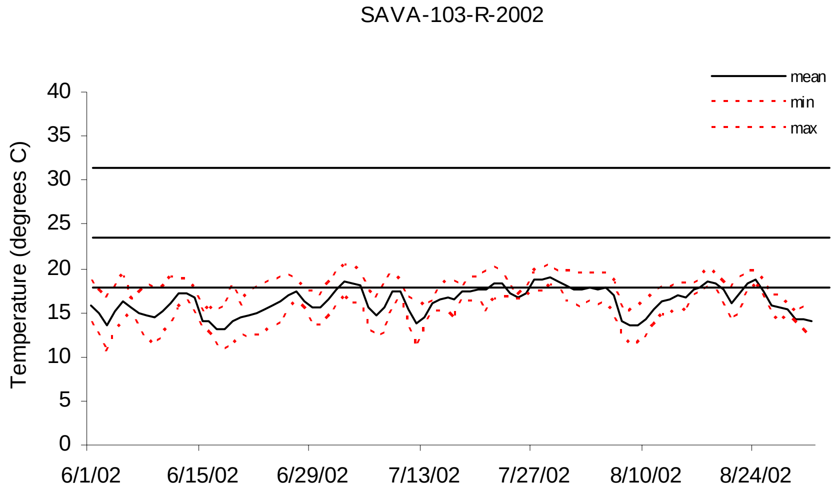


Figure 3-33. Mean, minimum and maximum daily temperatures (degrees Celsius) for a coldwater stream sampled in MBSS 2002, SAVA-103-R-2002. Period of record was from June 1, 2002 to August 31, 2002.

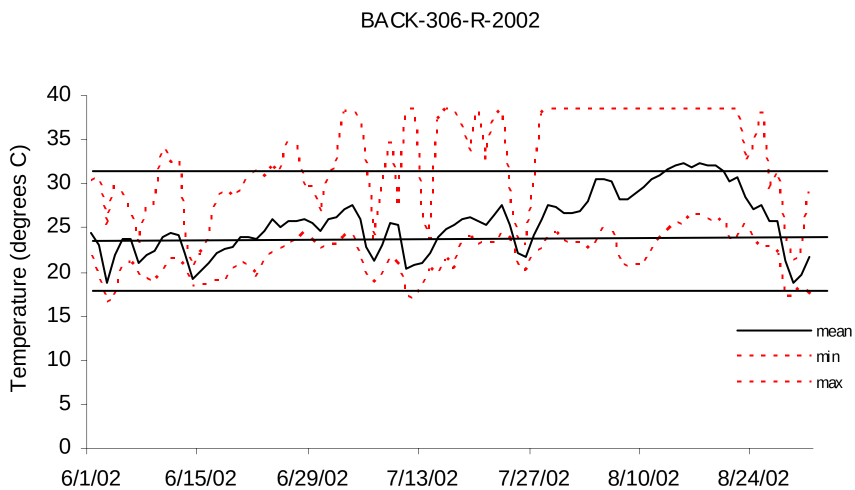


Figure 3-34. Mean, minimum and maximum daily temperatures (degrees Celsius) for a warmwater stream sampled in MBSS 2002, BACK-306-R-2002. Period of record was from June 1, 2002 to August 31, 2002.

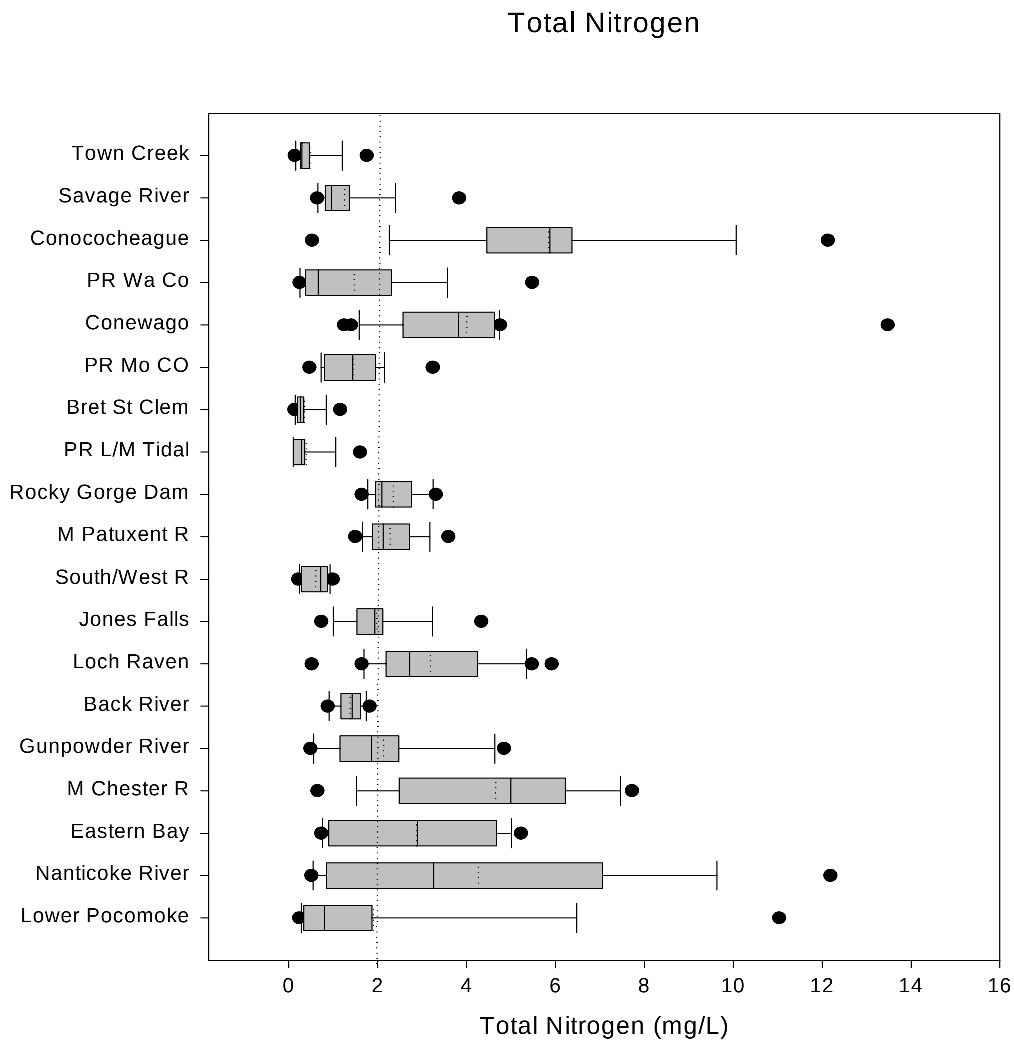


Figure 3-35. Distribution of total nitrogen values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

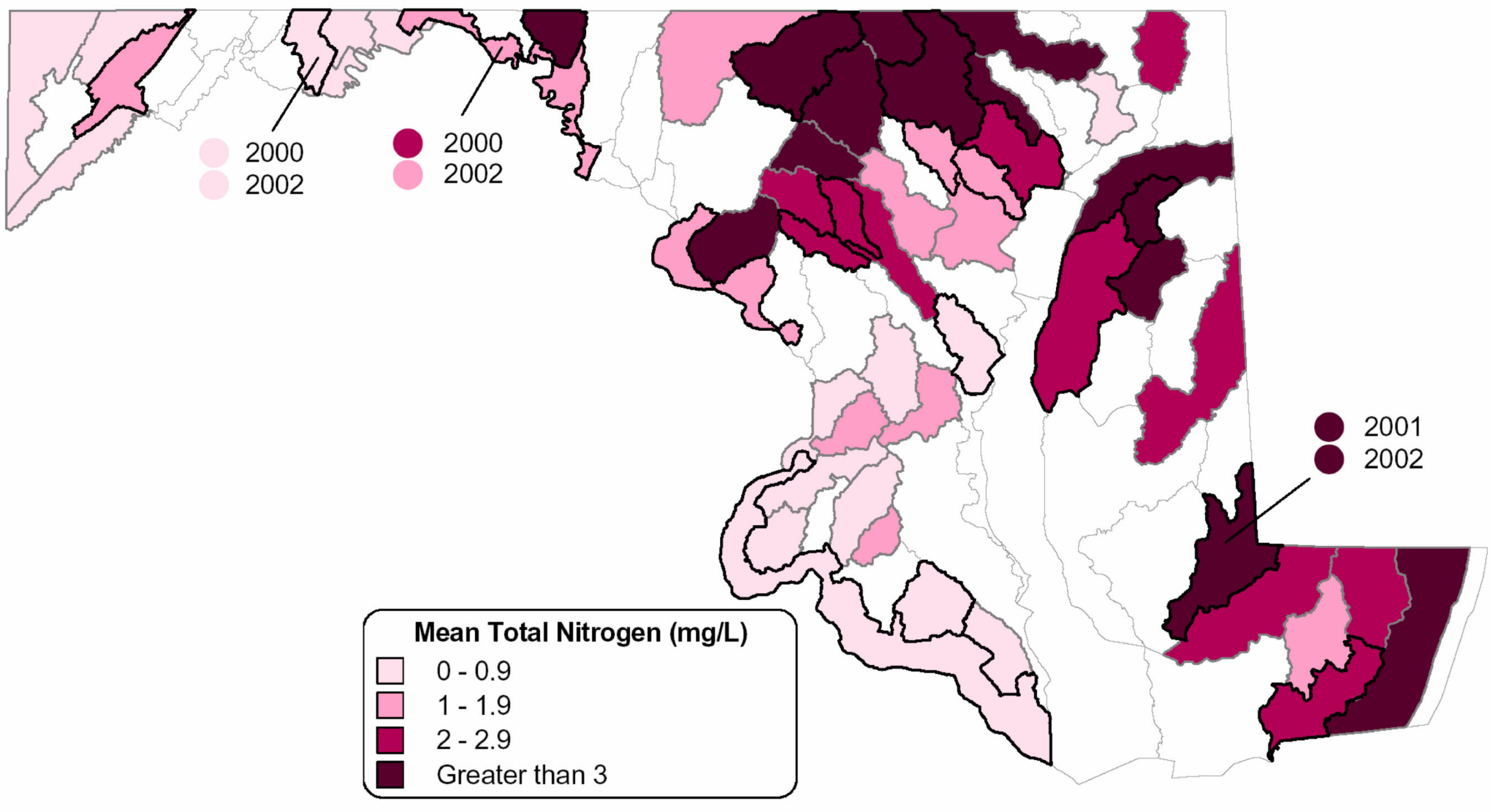


Figure 3-36. Distribution of total nitrogen values (mg/L) for the MBSS PSUs sampled in 2000, 2001, and 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

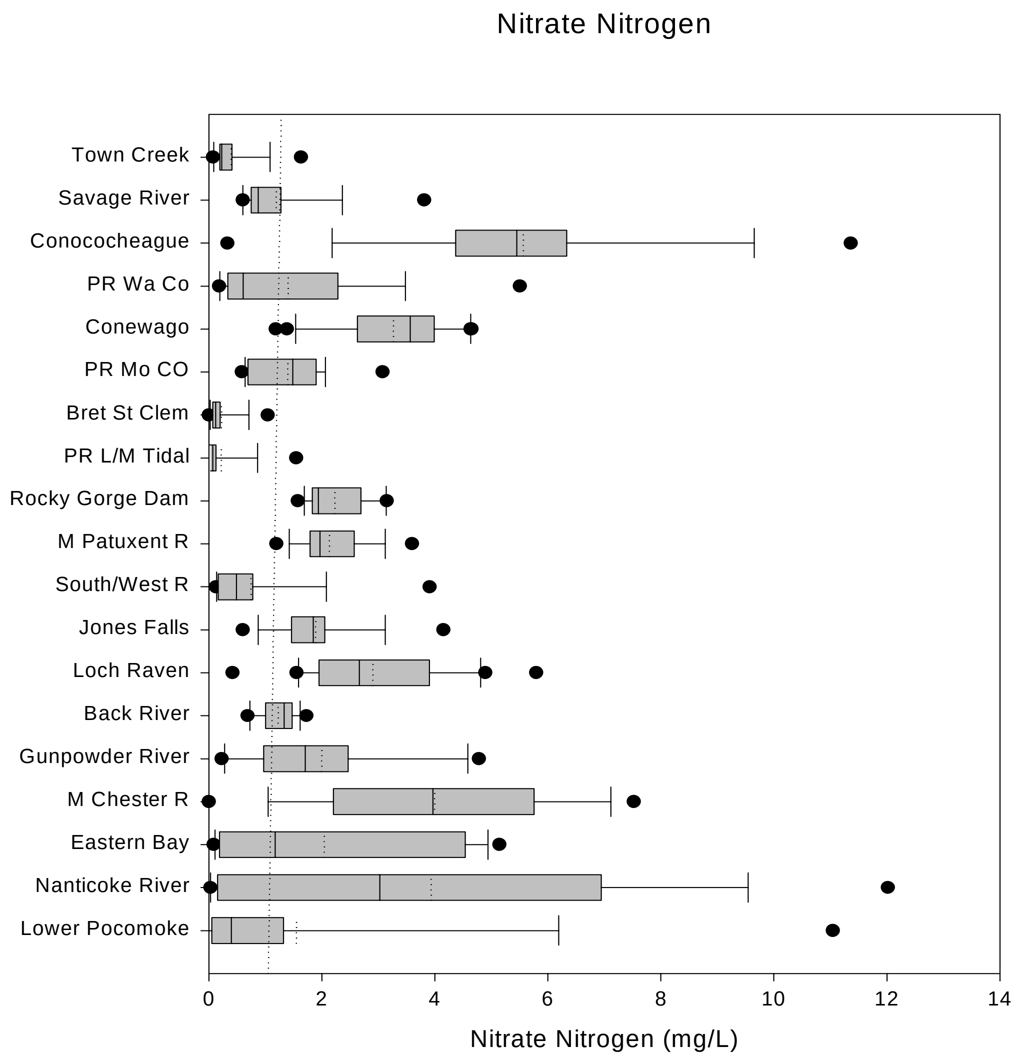


Figure 3-37. Distribution of nitrate-nitrogen values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

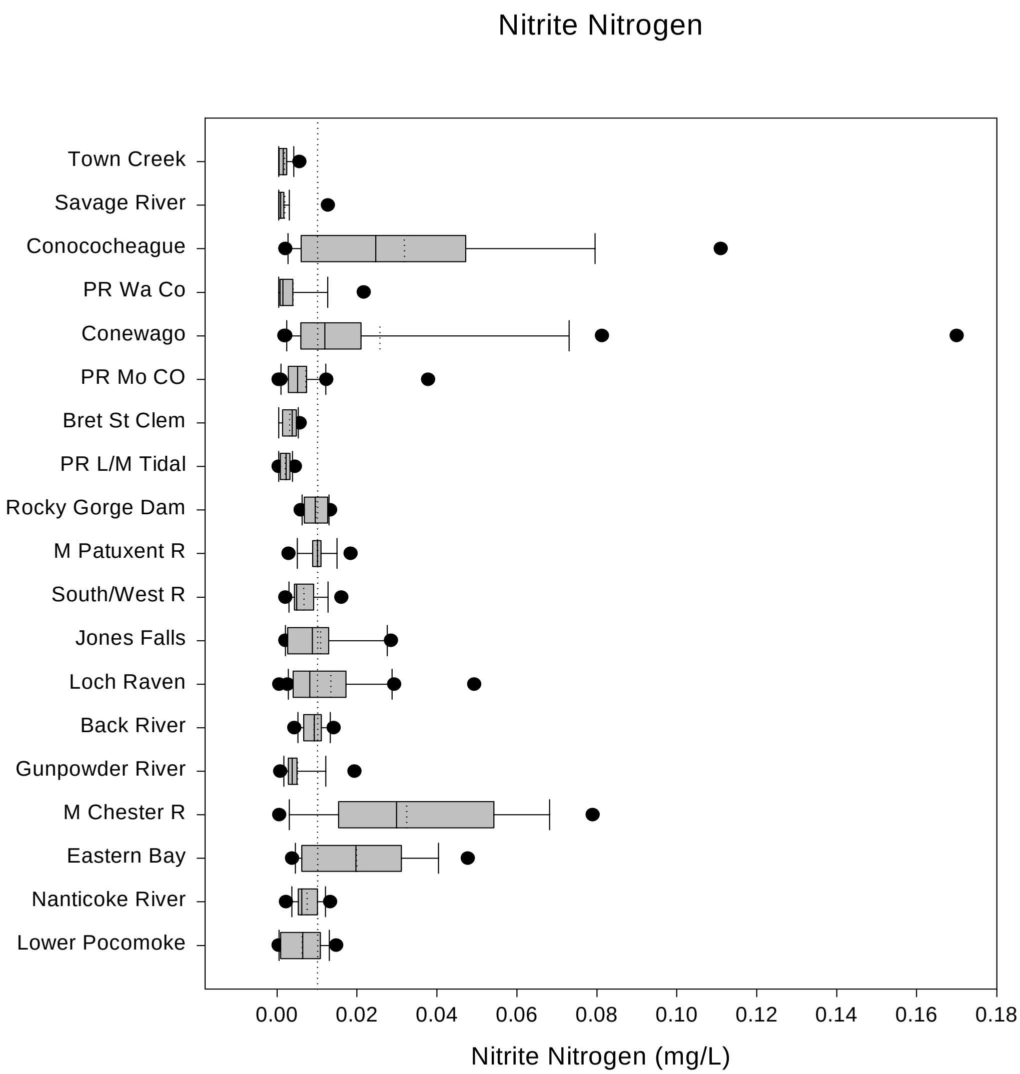


Figure 3-38. Distribution of nitrite-nitrogen values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

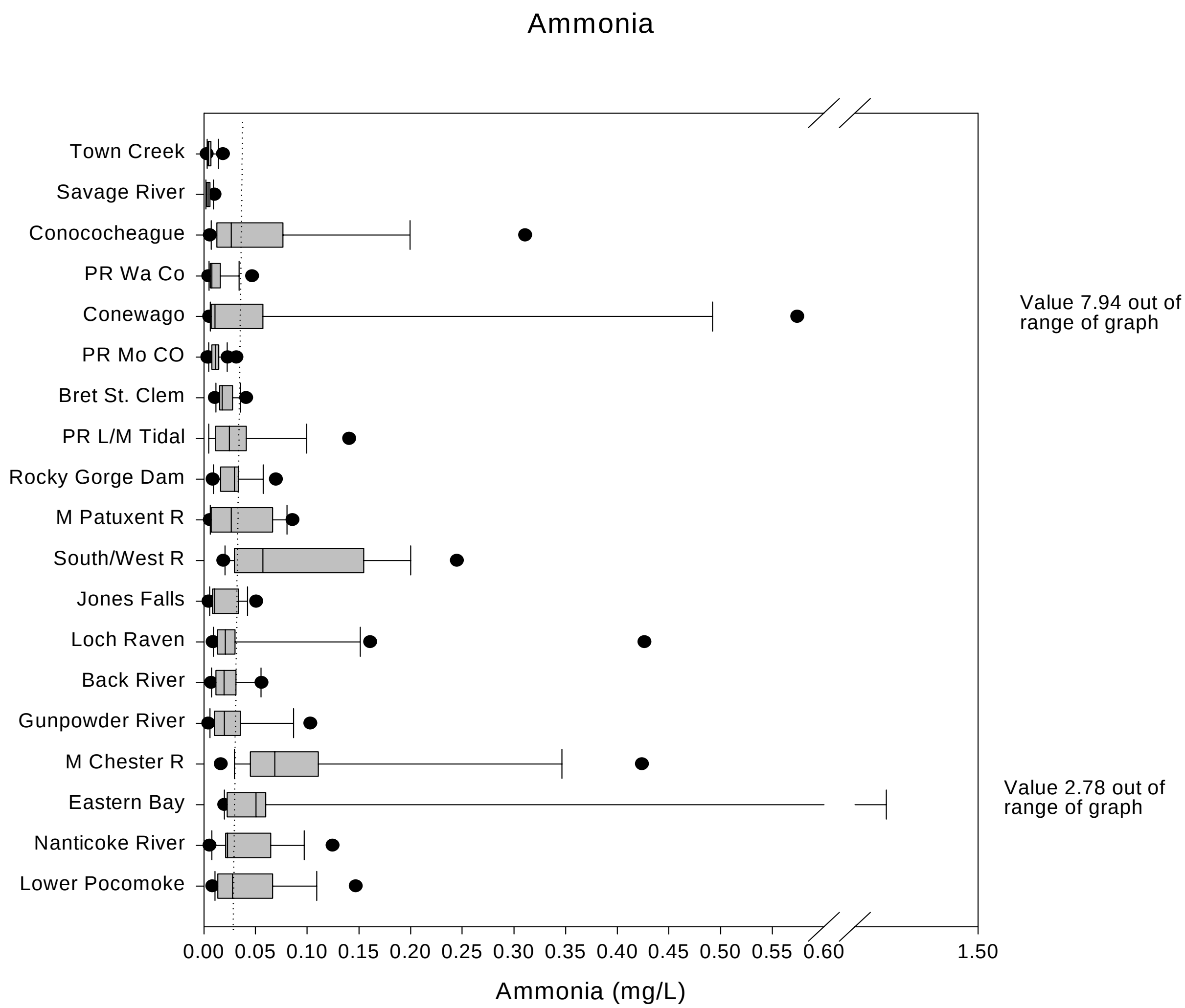


Figure 3-39. Distribution of ammonia values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

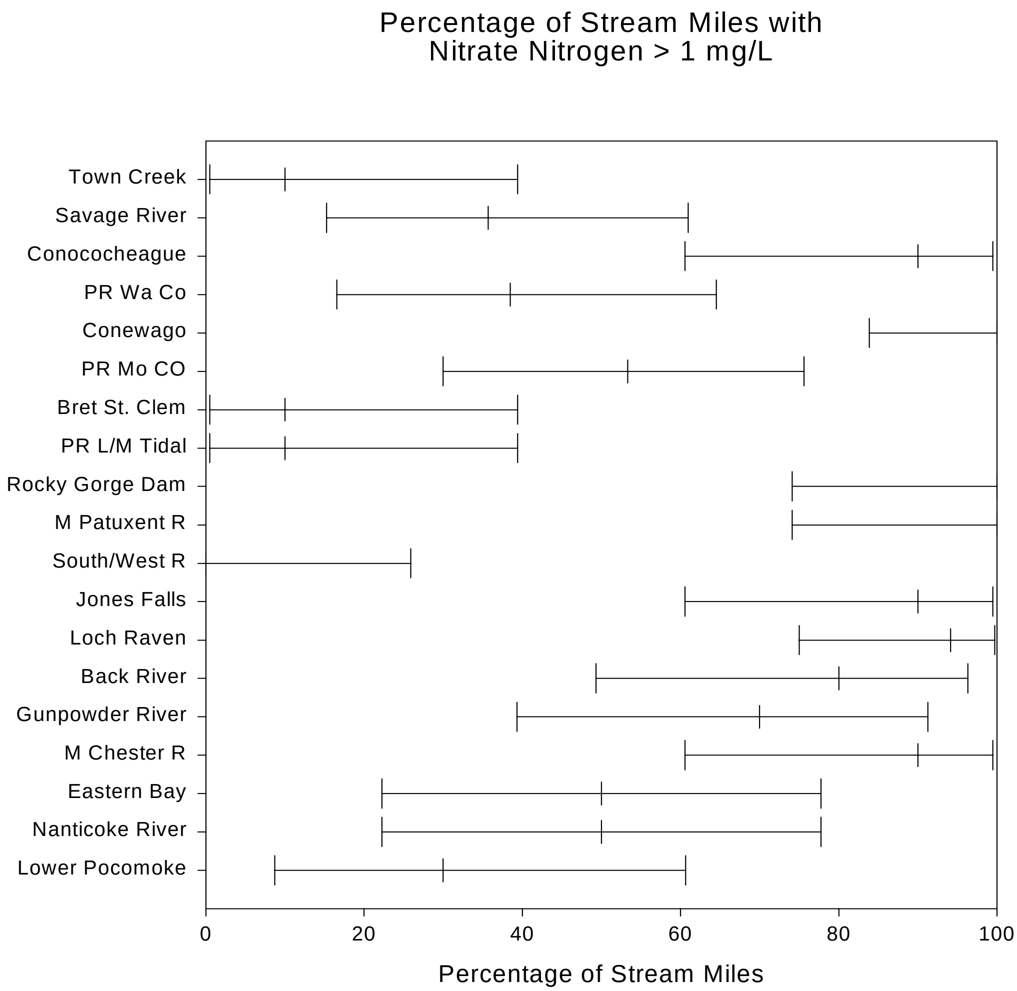


Figure 3-40. Percentage of stream miles with nitrate-nitrogen greater than 1.0 mg/L for the MBSS PSUs sampled in 2002

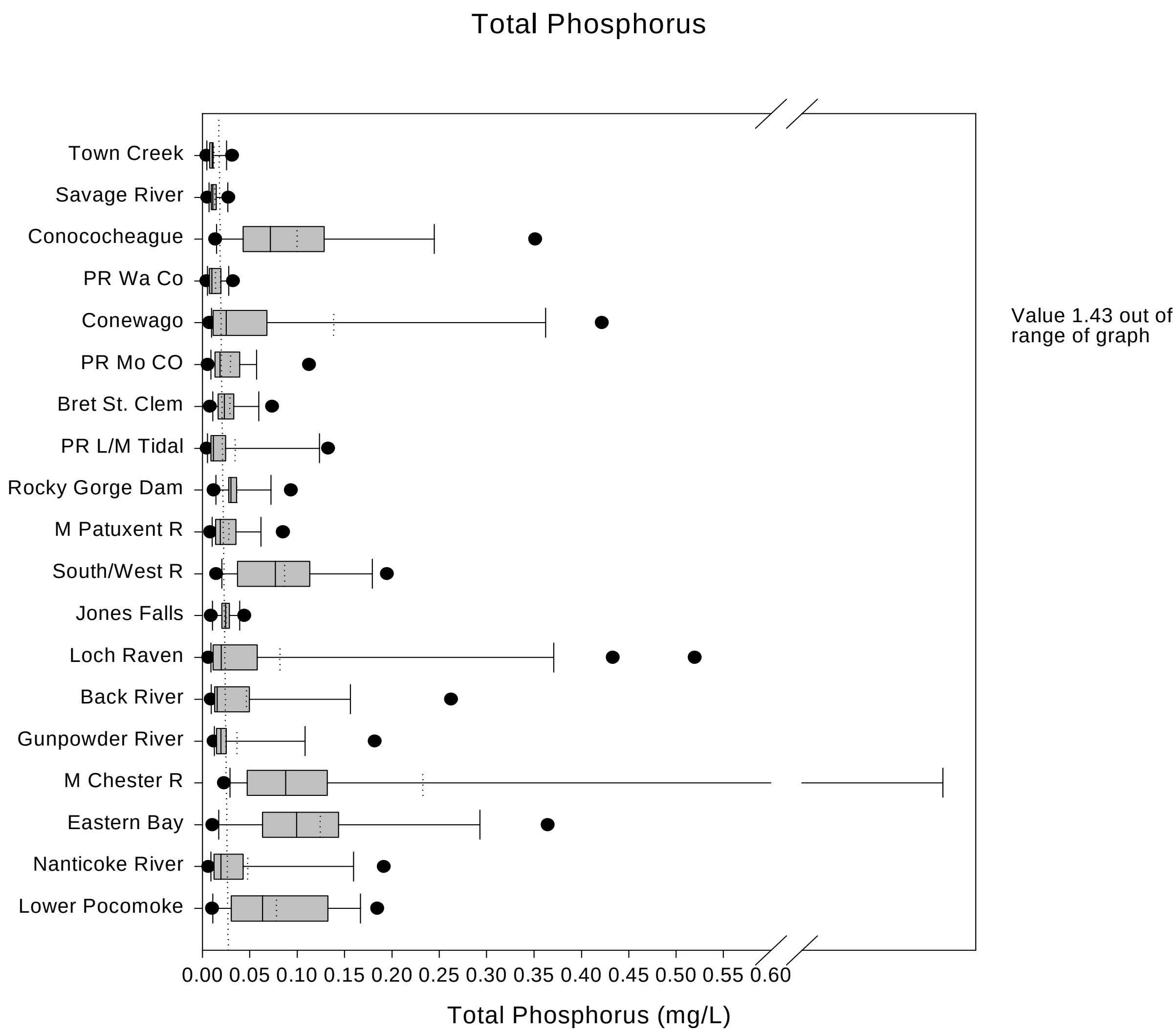


Figure 3-41. Distribution of phosphorus values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

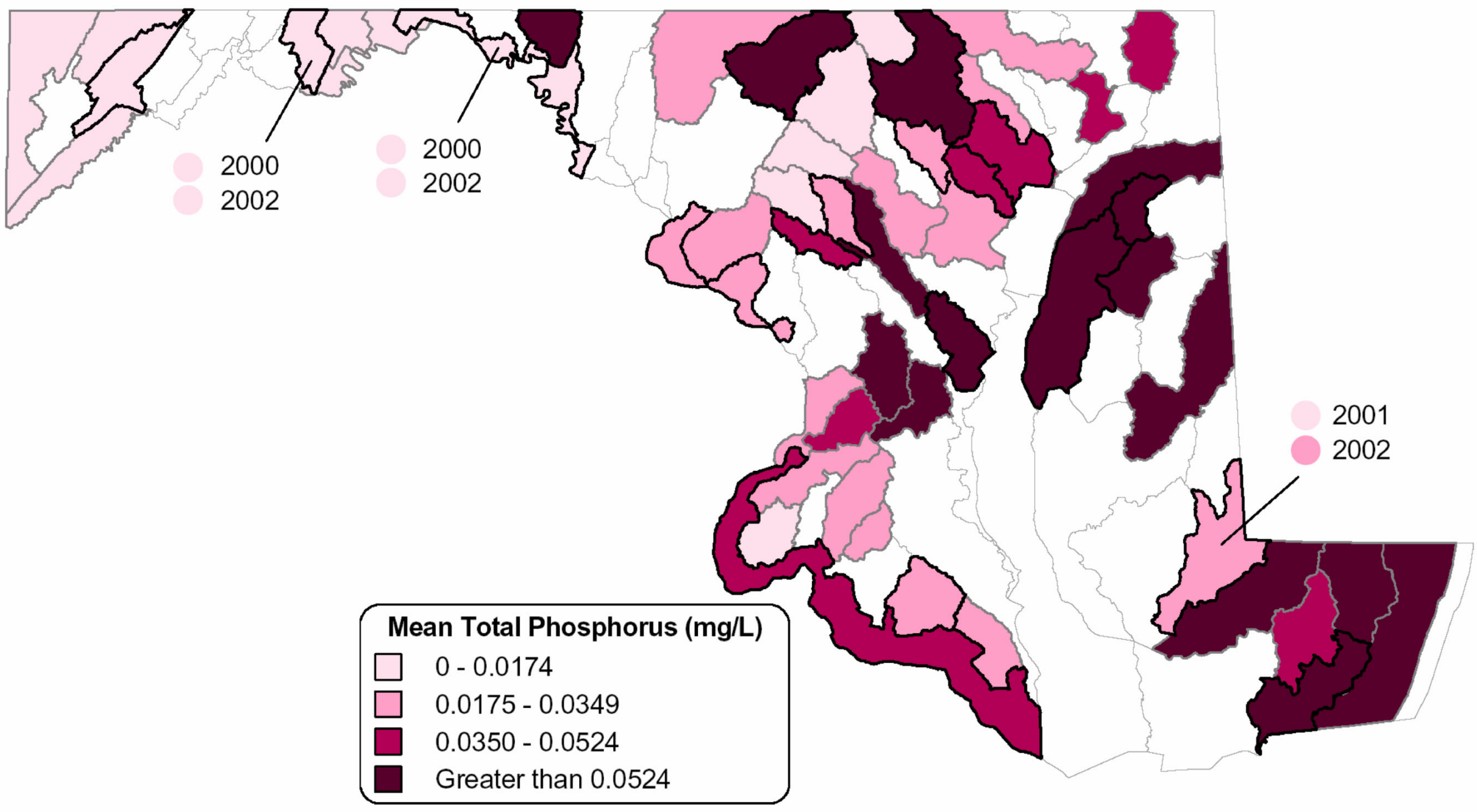


Figure 3-42. Distribution of total phosphorus values (mg/L) for the MBSS PSUs sampled in 2002. PSUs sampled in 2002 have bolder outlines than those sampled in 2000 and 2001. Three PSUs that were sampled in 2000 or 2001 were also sampled in 2002.

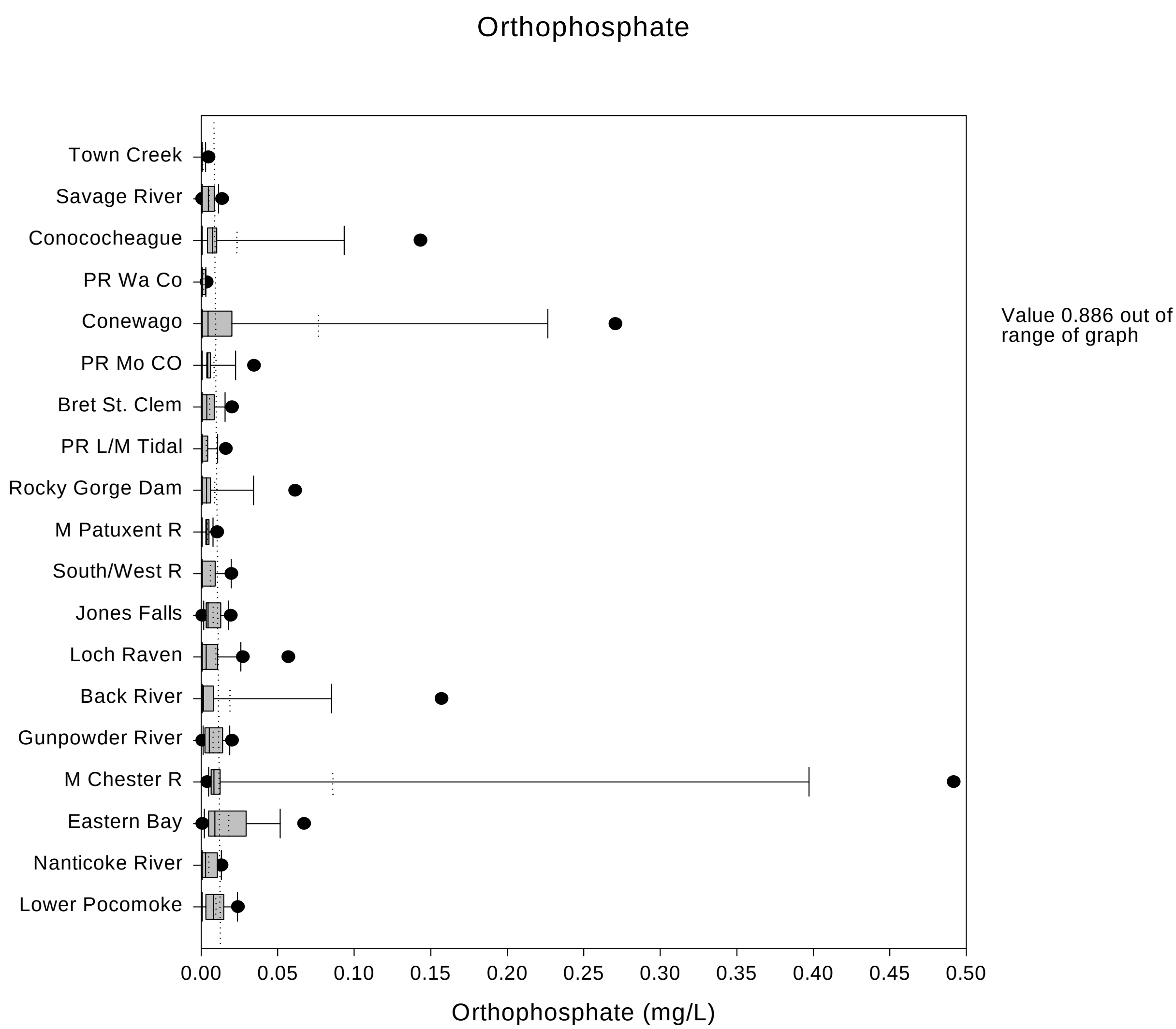


Figure 3-43. Distribution of orthophosphate values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

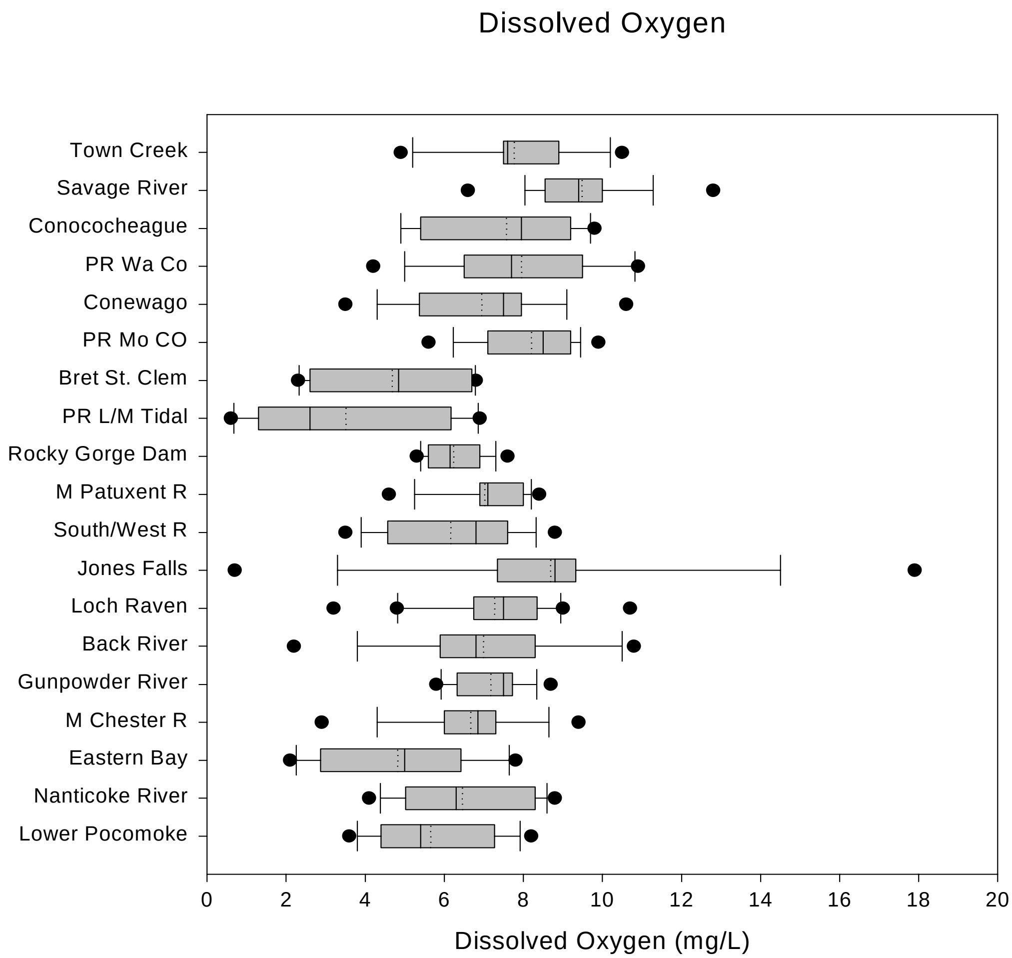


Figure 3-44. Distribution of dissolved oxygen concentrations (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold below which anthropogenic influences on stream conditions are likely.

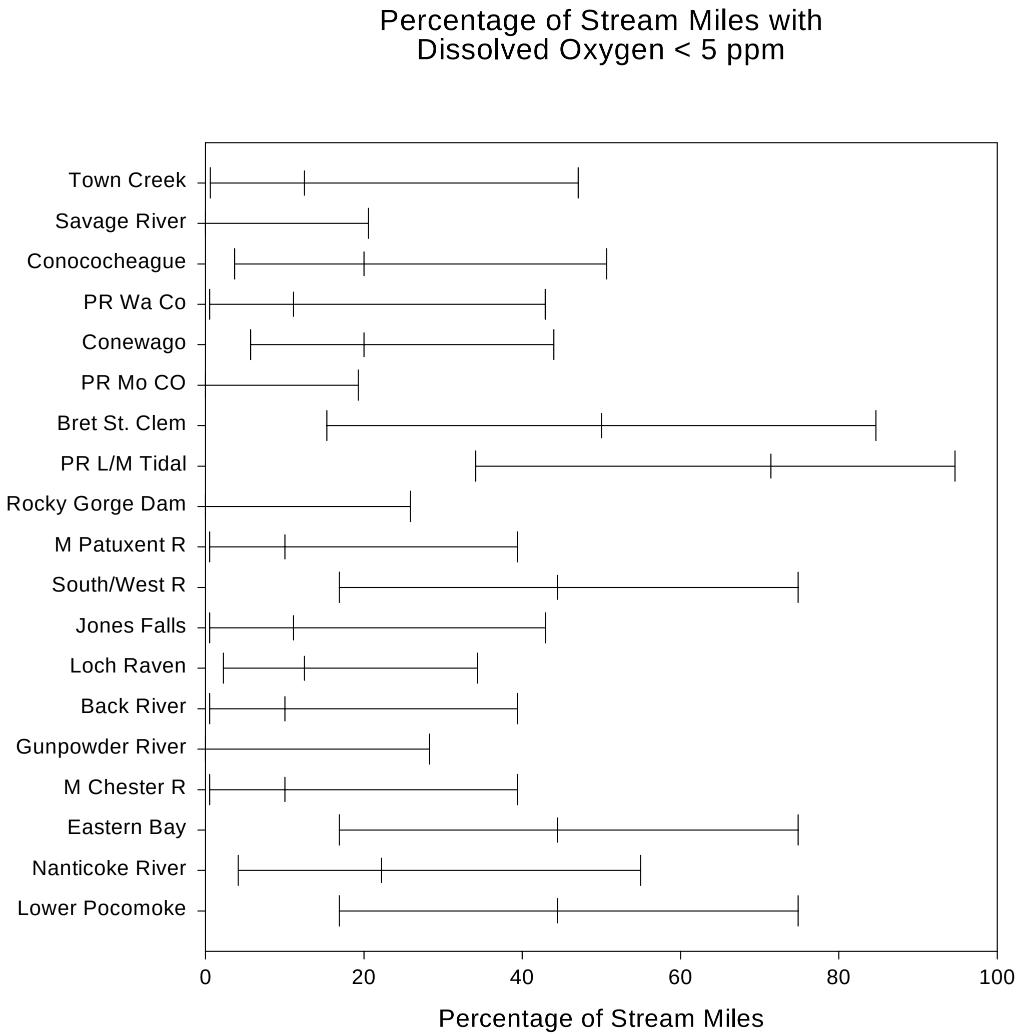


Figure 3-45. Percentage of stream miles with dissolved oxygen concentrations < 5.0 mg/L for the MBSS PSUs sampled in 2002

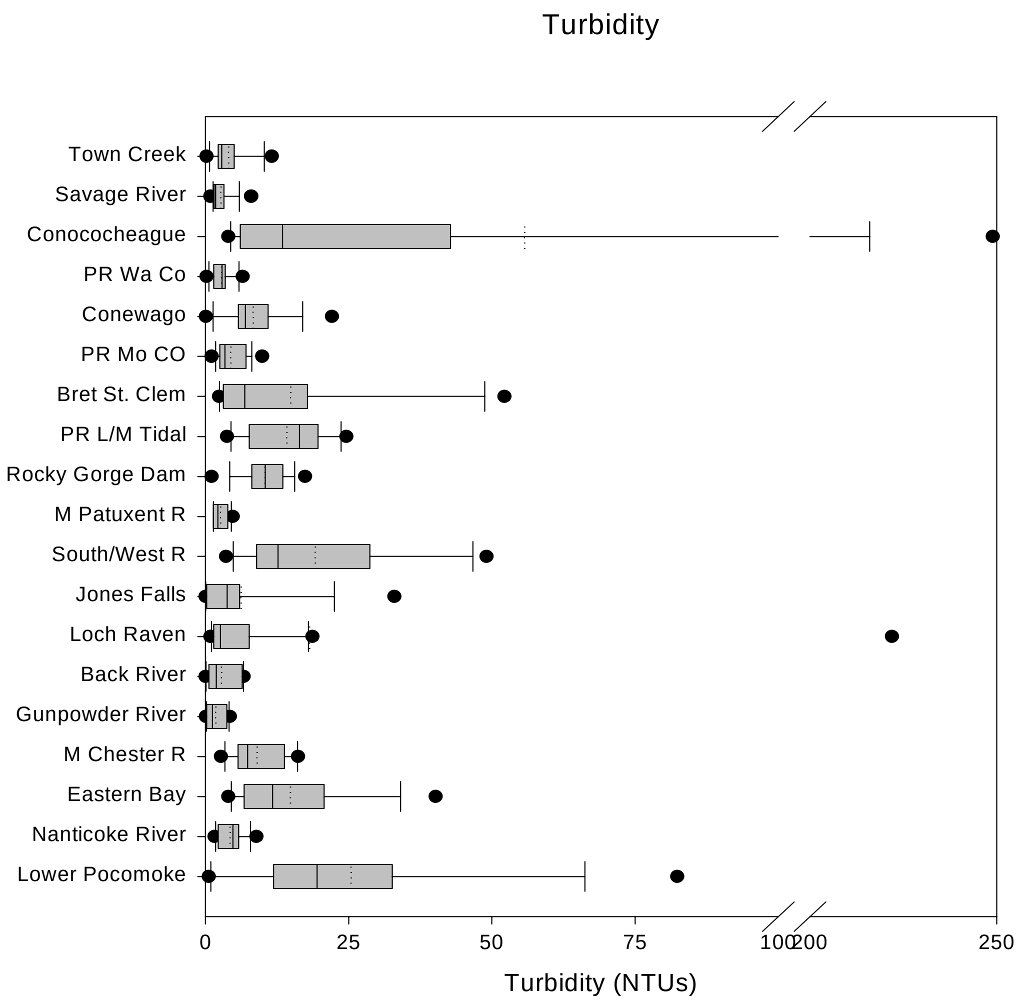


Figure 3-46. Distribution of turbidity values (NTUs) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

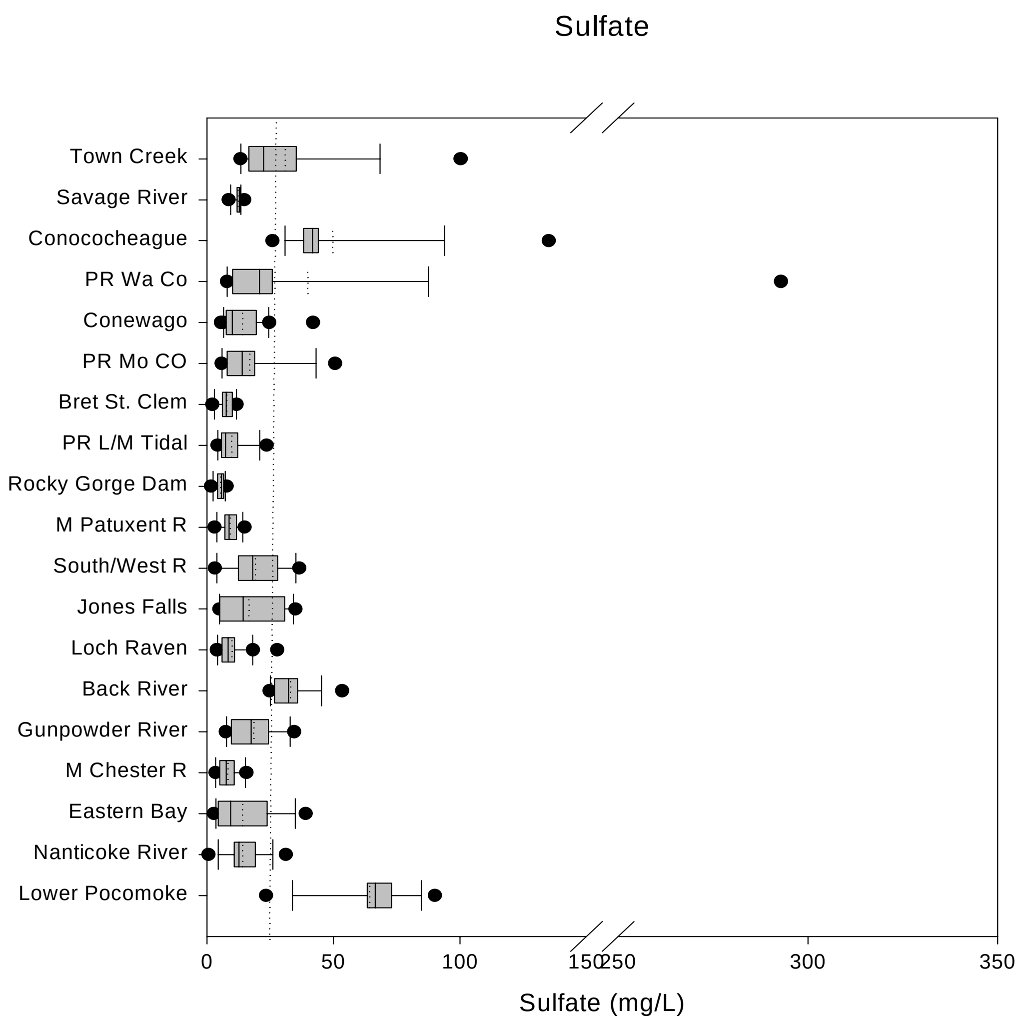


Figure 3-47. Distribution of sulfate values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

Sulfate values were not generally high (Figure 3-47, Appendix Table B-36), although many PSUs had maximum values greater than the 30 mg/L threshold established for sulfate disturbances. PSUs in Western Maryland such as the Potomac River Washington County PSU, Conococheague, and Town Creek each had some sites with elevated sulfate values, although these values could not be directly attributed to acidification due to Acid Mine Drainage. The Lower Pocomoke River had the highest mean sulfate concentration (63 mg/L).

Chloride (Figure 3-48 , Appendix Table B-37) tended to highest in the urban areas - especially in Central Maryland. The sites in these PSUs have a higher probability of being located close to major highways where high chloride levels may be the result of road salt application.

As expected, mean dissolved organic carbon (DOC; Figure 3-49, Appendix Table B-38) was highest in Coastal Plain basins, especially on the Eastern Shore, where blackwater stream conditions are most prevalent.

3.6 LAND USE

A measure of anthropogenic influence at the landscape scale is watershed land use. Watersheds form natural geographic units for assessing impacts on streams, because land use within the watershed (or catchment) upstream of a specific stream site is representative of many of the human activities affecting the stream at that point. As such, land cover serves as a surrogate for a variety of stressors.

In much of the United States, conversions of naturally vegetated watershed lands to urban and agricultural uses

The greatest amounts of agricultural land uses in upstream catchments occurred in PSUs sampled on the Eastern Shore and in several PSUs in central Maryland (Figure 3-51, Appendix Table B-40). Middle Chester River had the highest mean agricultural land use (85%), followed by Conococheague (80%), Conewago/Double Pipe Creeks (75%), and the Eastern Bay PSU (74%).

Western Maryland contains the PSUs with the largest amounts of forested land use in the state (Figure 3-52, Appendix Table B-41). Town Creek had the largest mean percentage of forest land use in upstream catchments (84%, including one site with 100% forested land use in the upstream catchment). Although not in western Maryland, Potomac River Lower Tidal/Potomac River Middle Tidal had the next largest percentage of forested land use in upstream catchments (81%), followed by two

have resulted in serious impacts to streams and their aquatic inhabitants. Some investigations have indicated that development of even small portions of the watershed area can have detrimental effects on streams (Schueler 1994). Impervious surfaces, such as roads, parking lots, sidewalks, and rooftops, cause a rapid increase in the rate at which water is transported from the watershed to its stream channels. Effects include more variable stream flows, increased erosion from runoff, habitat degradation caused by channel instability, increased nonpoint source pollutant loading, elevated temperatures, and losses of biological diversity.

Reviews of stream research in numerous watersheds (Center for Watershed Protection 1998, Schueler 1994) indicate that impacts on stream quality are commonly noted at about 10% coverage by impervious surface. Effects on sensitive species may occur at even lower levels. With even more impervious surface, most notably, at about 25-30% of catchment area, studies have shown that numerous aspects of stream quality become degraded, including biological integrity, water quality, and physical habitat quality (Center for Watershed Protection 1998).

Of the 19 PSUs sampled in 2002, the greatest amounts of urban land occurred in PSUs located in the central portion of the state (Figure 3-50, Appendix Table B-39). Back River has the highest mean percentage of urban land use in upstream catchments (73%), while several PSUs - Potomac River Montgomery County, Jones Falls, and the Gunpowder River PSU - all have sites with greater than 50% urban land use. PSUs in western Maryland and on the Eastern Shore had much smaller percentages of urban land in catchments upstream of MBSS sites. The percentage of impervious surface (calculated as 75% of the value for high density urban land use plus 25% of the value for low density urban land use) followed the patterns show in the percentage of urban land use.

western Maryland PSUs — Savage River (76%) and the Potomac River Washington County PSU (69%).

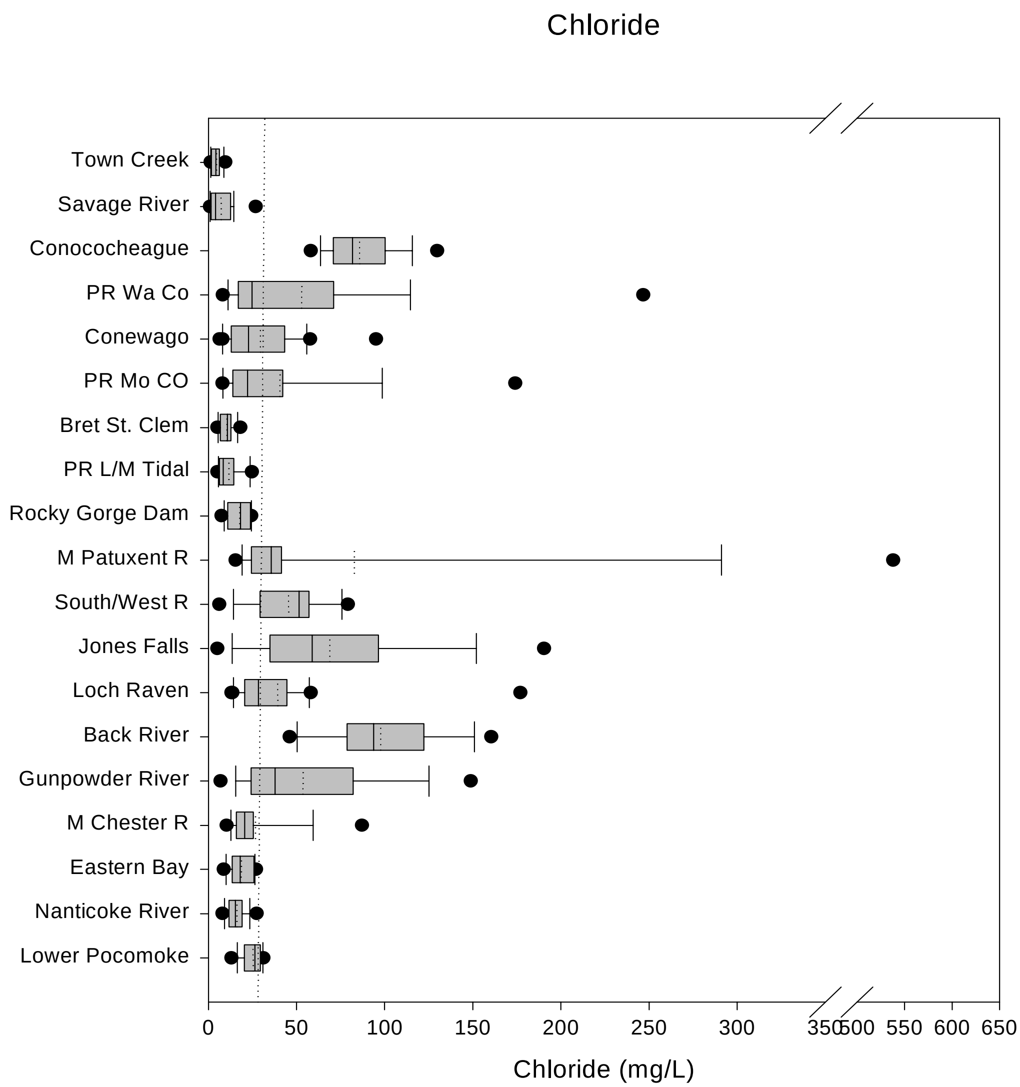


Figure 3-48. Distribution of chloride values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which anthropogenic influences on stream conditions are likely.

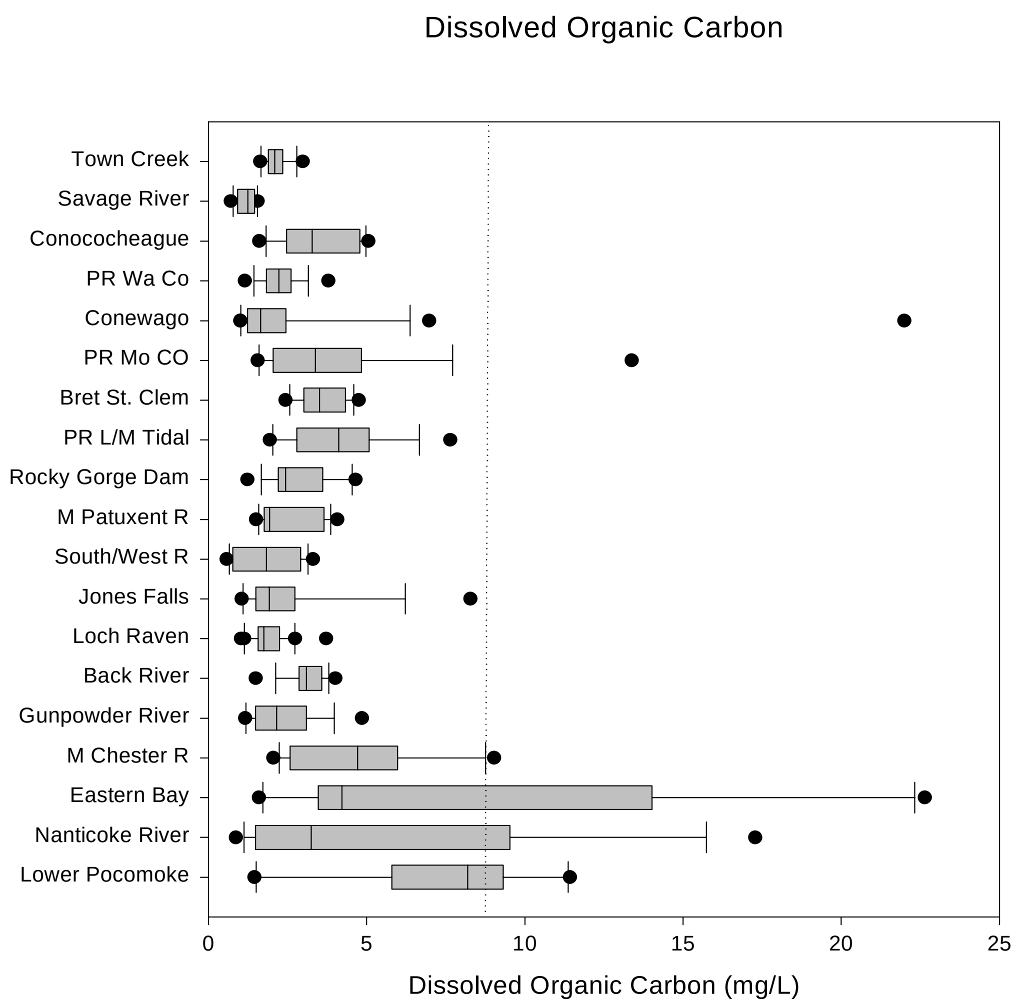


Figure 3-49. Distribution of dissolved organic carbon values (mg/L) for the MBSS PSUs sampled in 2002. Dotted line represents threshold above which blackwater stream conditions or (less commonly) anthropogenic impacts are likely.

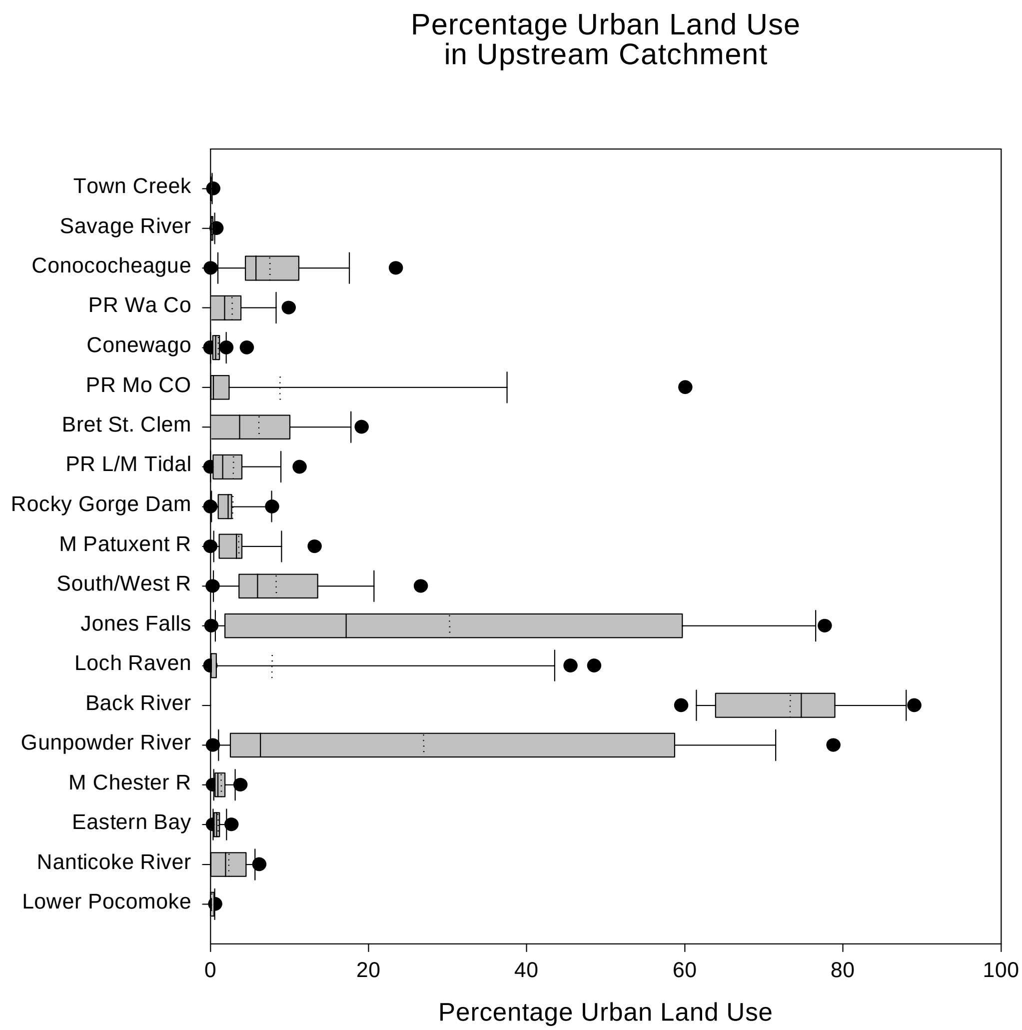


Figure 3-50. Distribution of the percentage of urban land in the catchments upstream of the MBSS 2002 sites

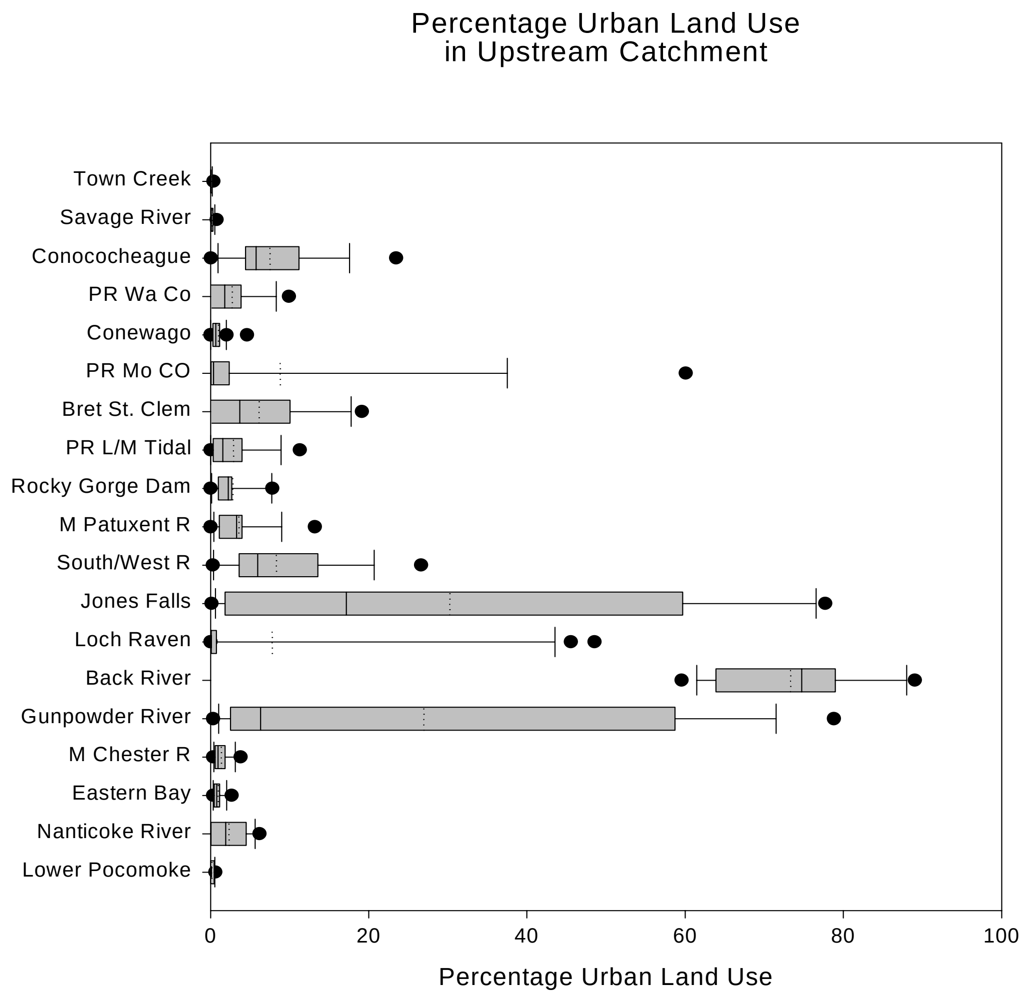


Figure 3-51. Distribution of the percentage of agricultural land in the catchments upstream of the MBSS 2002 sites

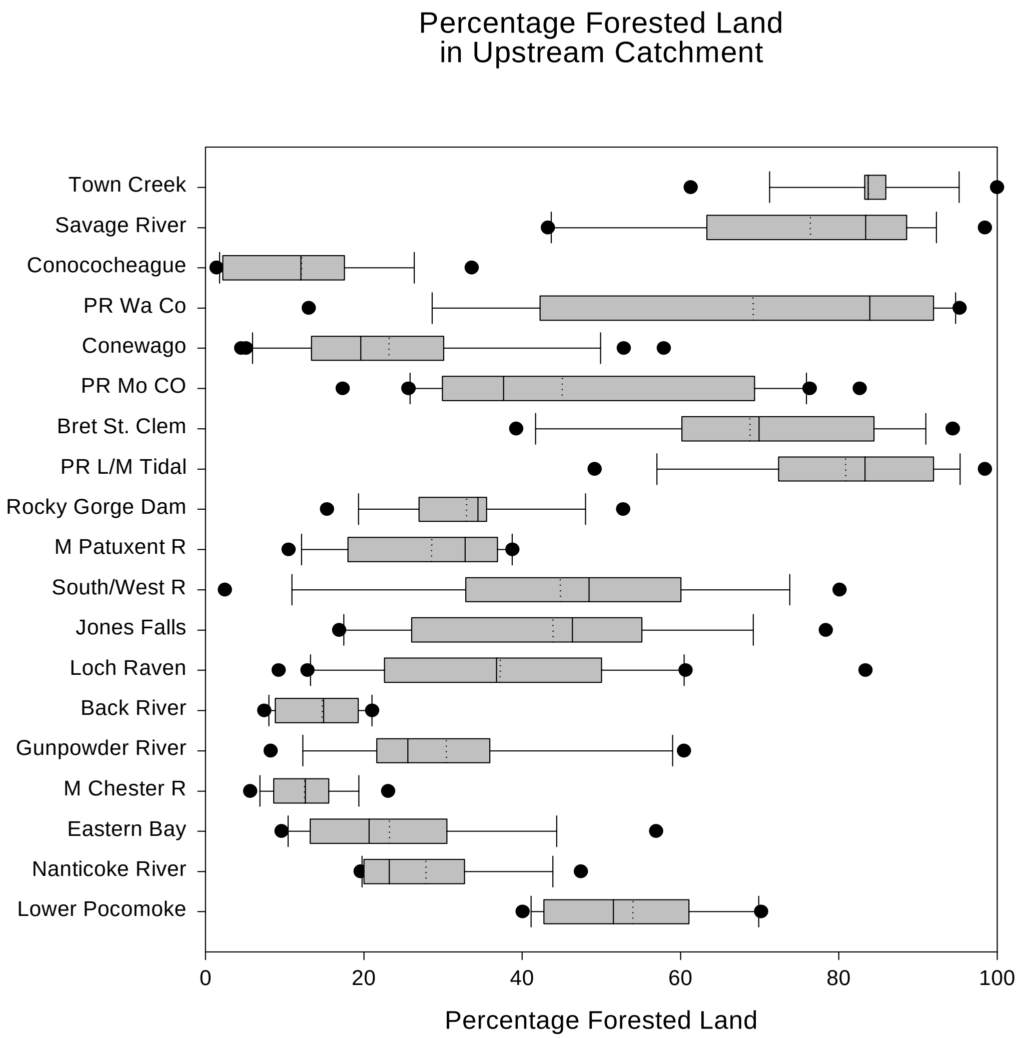


Figure 3-52. Distribution of the percentage of forested land in the catchments upstream of the MBSS 2002 sites

4 SUMMARY OF SAMPLING RESULTS FOR INDIVIDUAL WATERSHEDS

Since the primary focus of the 2000-2004 Round Two of the MBSS (or Survey) is on smaller watersheds than in Round One, more attention has been paid to examining sampling results and potential stressors at individual sites. Although a complete assessment of watershed-wide conditions would require more information, data collected at specific MBSS sites provide a starting point for understanding and describing the condition of the watershed.

This chapter includes a summary for each of the 18 primary sampling units or PSUs (single or combined 8-digit watersheds) randomly sampled in the 2001 MBSS. Each summary begins with a map of the PSU, which shows 8-digit watershed and 12-digit subwatershed boundaries, county boundaries, major towns and roads, and selected public lands. This information provides a geographical context for the sites sampled by the Survey. These maps also include the locations of the MBSS sample points and MBSS Stream Waders sample locations (see sidebar in this chapter for further information regarding the MBSS Stream Waders program), with symbols indicating the fish and benthic IBI scores (a key to this map is included in Table 4-1). The same page of each PSU summary lists the total land area and the total number of sampleable stream miles (by individual 8-digit watershed).

Each PSU summary includes a land cover map derived from the Multi-Resolution Land Characteristics (MRLC) Version 98-07 (based on remote sensing data from the early 1990s). A key to this map is provided in Table 4-1. A bar chart for each 8-digit watershed shows the percentage of land in each land cover class.

Following the maps are tables containing a variety of information on the sites sampled in each PSU. The first table contains locational information for each site, including the stream name, 12-digit subwatershed code,8-digit watershed name, basin, county, stream order, and upstream catchment area. The second table is one containing information pertinent to the indicators calculated for each site (fish, benthic, and physical habitat). The third table gives the percentage of the upstream catchment area in urban, agricultural, forested, or other (water, barren, and/or wetlands) land cover for each site. Below these tables is a short summary of the conditions in the PSU, including pertinent comments taken from field data sheets. A water chemistry table is provided, including values for the analytes measured at each site (see Chapter 2). Two tables providing information on physical habitat quality and modifications are also included in each PSU report. Throughout these tables, values that exceed or fall short of established thresholds (denoting likely degraded condition or potential stress) are shaded in yellow. The final table is a list of Stream Waders sites in the PSU, along with the family level IBI score calculated for each site. A key to the variables in all of these tables is given in Table 4-1.

Finally, each PSU report includes a list of organisms found throughout the PSU. Included on this page are species lists for fish, exotic plants, and herpetofauna, as well as a taxa list for benthic macroinvertebrates. Taken together, these data can be used to begin to assess stream quality in each PSU. For example, in the Potomac River Upper Tidal/Oxon Creek PSU, indicator scores at most sites are generally low, indicating that most streams sampled in the PSU are disturbed. Maps and data also indicate that urban and suburban land uses are widespread and that many sampled sites had elevated chloride, nitrogen (especially ammonia), and phosphorus levels, as well as channelization and erosion problems. In this PSU, development is probably a significant stressor on stream water quality, contributing to elevated pollution and physical habitat degradation, which in turn result in low indicator scores. A similar assessment can be done for each PSU, providing a preliminary identification of the specific stressors of concern in the PSU.

Table 4-1. Key to PSU reports for PSUs sampled in the 2002 MBSS

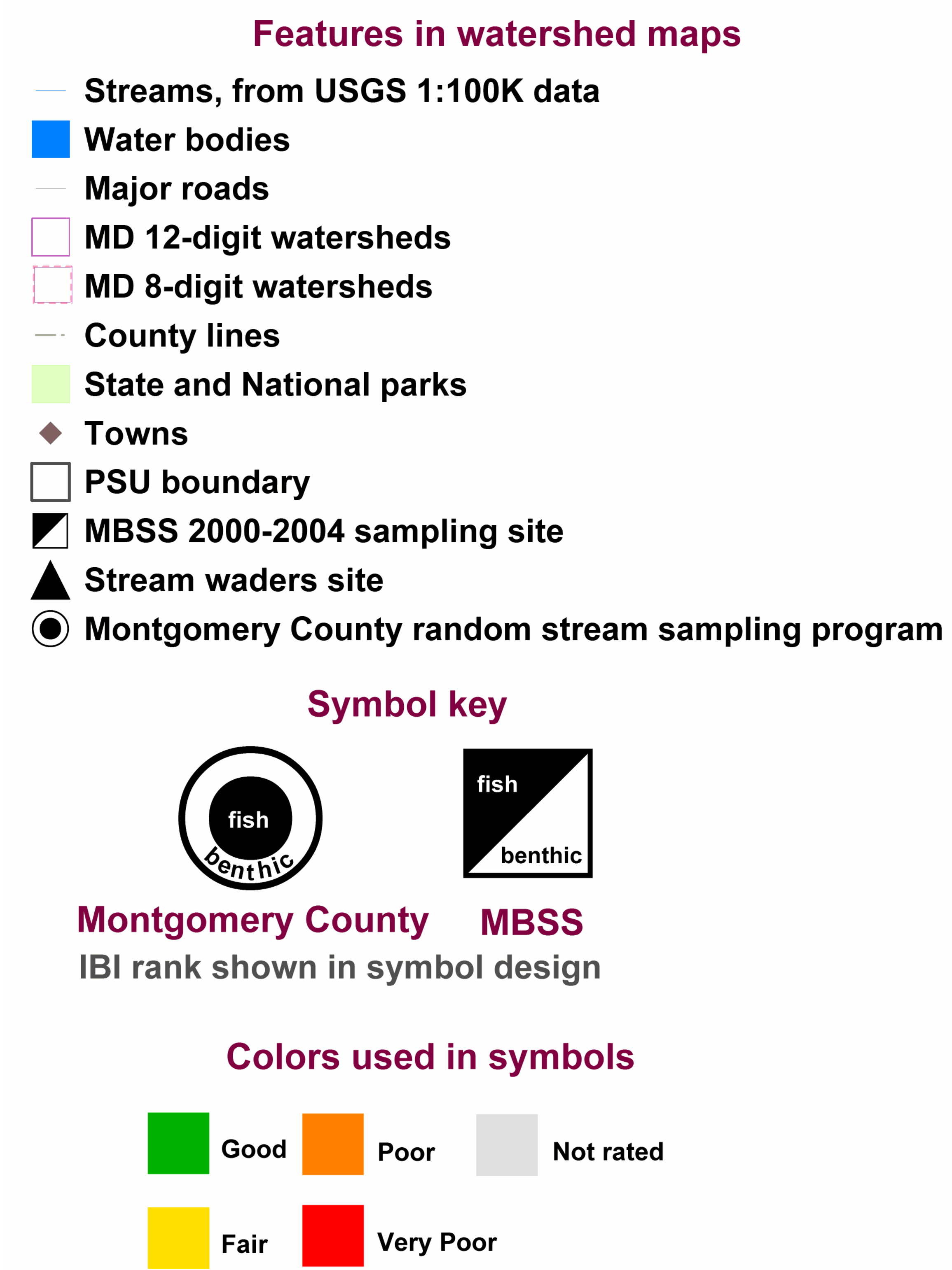


Table 4-1. (Continued)

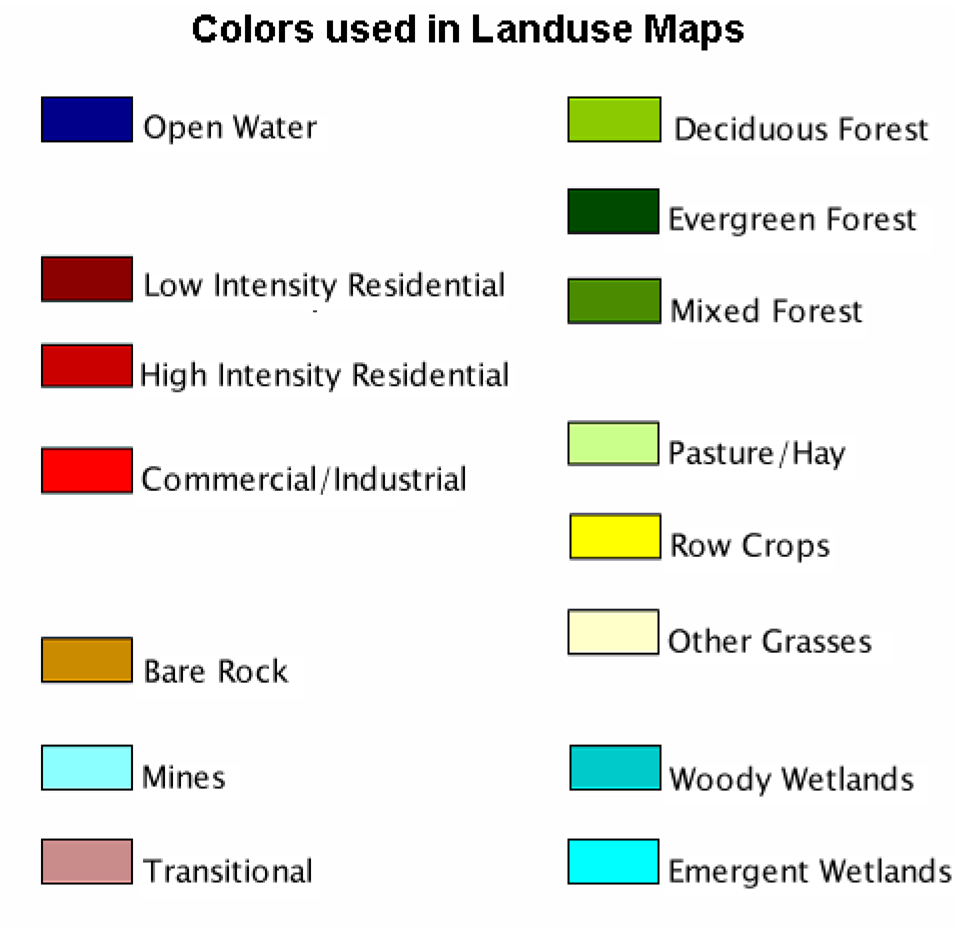


Table 4-1. (Continued)

Guide to Variables in PSU Reports

Site Information

Site: MBSS site name, in the following format: Watershed Abbreviation - Segment Number - Site Type - Year Sampled (Site Type R = Randomly selected site)

Stream Name: Name of stream sampled

12-digit Subwatershed Code: Maryland 12-digit watershed code

8-digit Watershed: Maryland 8-digit watershed name

Basin: Maryland drainage basin name

County: Maryland county

Date Sampled Spring: Date site was sampled in the spring

Date Sampled Summer: Date site was sampled in the summer (NS = Not Sampled)

Order: Strahler stream order

Catchment Area: Area of upstream catchment in acres

Indicator Information

FIBI: Fish Index of Biotic Integrity, scored on the following scale:

1.0 - 1.9 Very Poor
2.0 - 2.9 Poor
3.0 - 3.9 Fair
4.0 - 5.0 Good
NS Not Sampled
NR Not Rated (site is not rated if catchment area is < 300 acres, or if the site is a brook trout or blackwater stream and would have received a score of less than 3.0)
Site is shaded if IBI score is < 3.0

BIBI: Benthic Index of Biotic Integrity, scored on the following scale:

1.0 - 1.9 Very Poor
2.0 - 2.9 Poor
3.0 - 3.9 Fair
4.0 - 5.0 Good
NS Not Sampled
NR Not Rated
Site is shaded if IBI score is < 3.0

Table 4-1. (Continued)

PHI: Physical Habitat Index, scored on the following scale:
- 0 - 11.9 Very Poor
- 12 - 41.9 Poor
- 42 - 71.9 Fair
- 72 - 100 Good
- NS   Not Sampled
- NR   Not Rated
- Site is shaded if PHI score is < 42

Brook Trout Present: 0 = Not present in sample segment, 1 = Present in sample segment, NS = Not Sampled

Black Water Stream: 0 = Not a blackwater stream, 1 = Blackwater stream (pH < 5 or ANC < 200 µeq/L and Dissolved Organic Carbon ≥ 8 mg/L),
NS = Not Sampled

Catchment Land Use Information

Percent Urban: Percentage of urban land use in catchment upstream of site. Site is shaded if value is ≥ 25%.

Percent Agriculture: Percentage of agricultural land use in catchment upstream of site. Site is shaded if values is ≥ 75%.

Percent Forest: Percentage of forested land use in catchment upstream of site

Percent Other: Percentage of other land use in catchment upstream of site (other = wetlands, barren, and water)

Percent Impervious Surface: Percentage of impervious surface in catchment upstream of site. Site is shaded if value is ≥ 10%

Water Chemistry Information

Closed pH: Lab pH, sampled in the spring. Site is shaded if value is < 5.0.

Specific Cond.: Specific Conductivity (μmho/cm)

ANC: Acid Neutralizing Capacity (μeq/L). Site is shaded if value is < 200 ueq/L.

Cl: Chloride (mg/L). Site is shaded if value is ≥ 30 mg/L.

Nitrate-N: Nitrate Nitrogen (mg/L). Site is shaded if value is ≥ 1.0 mg/L

SO4: Sulfate (mg/L). Site is shaded if value is ≥ 50 mg/L.

T-P: Total Phosphorus (mg/L). Site is shaded if value is ≥ 0.0175 mg/L.

Ortho-P: Orthophosphate (mg/L). Site is shaded if value is ≥ 0.005 mg/L.

Nitrite: Nitrite Nitrogen (mg/L). Site is shaded if value is ≥ 0.0075 mg/L.

Ammonia: Ammonia (mg/L). Site is shaded if value is ≥ 0.025 mg/L.

T-N: Total Nitrogen (mg/L). Site is shaded if value is ≥ 2 mg/L

DOC: Dissolved Organic Carbon (mg/L). Site is shaded if value is ≥ 8.0 mg/L.

DO: Dissolved Oxygen (mg/L). Site is shaded if value is ≤ 5 mg/L.

Turbidity: Turbidity (NTUs). Site is shaded if value is ≥ 10 NTUs.

Table 4-1. (Continued)

Physical Habitat Condition

Riparian Buffer Width Left: Width of the riparian buffer on the left bank (meters). Site is shaded if value is < 10 m.

Riparian Buffer Width Right: Width of the riparian buffer on the right bank (meters). Site is shaded if value is < 10 m.

Adjacent Cover Left: Type of adjacent land cover on the left bank

Adjacent Cover Right: Type of adjacent land cover on the right bank

The following variables are scored on the following scale:

0-5 Poor
6-10 Marginal
11-15 Sub-optimal
16-20 Optimal
Sites are shaded if scores are ≤ 6.

Instream Habitat Structure: Scored based on the value of instream habitat to the fish community

Epifaunal Substrate: Scored based on the amount and variety of hard, stable substrates used by benthic macroinvertebrates

Velocity/Depth Diversity: Scored based on the variety of velocity/depth regimes present at a site

Pool/Glide/Eddy Quality: Scored based on the variety and complexity of slow or still water habitat present at a site

Riffle Run Quality: Scored based on the depth, complexity, and functionality of riffle/run habitat present at a site

Extent of Pools: The extent of pools, glides, and eddys present at a site (meters). Site is shaded if value is 0 m.

Extent of Riffles: The extent of riffles and runs present at a site (meters). Site is shaded if value is 0 m.

Embeddedness: Scored as a percentage (0-100) based on the fraction of surface area of larger particles surrounded by finer sediments. Site is shaded if value is 100%.

Shading: Scored as a percentage (0-100) based on estimates of the degree and duration of shading of sites during the summer. Site is shaded if value is 0%.

Trash Rating: Scored base on the visual appeal of the site and the presence/absence of human refuse. Site is shaded if value is ≤ 6.

Maximum Depth: Maximum depth of the stream (centimeters). Site is shaded if value is ≤ 20 cm.

Physical Habitat Modifications

Buffer Breaks?: Presence/absence of breaks in the riparian buffer, either right or left bank (Y/N). Site is shaded if value is Y.

Surface Mine?: Surface Mine present at the site (Y/N). Site is shaded if value is Y.

Landfill?: Landfill present at the site (Y/N). Site is shaded if value is Y.

Channelization: Stream channelization evident at the site (Y/N). Site is shaded if value is Y.

Erosion Severity Left - Severity of erosion on left bank (Severe, Moderate, Mild, or None). Site is shaded if value is Severe.

Erosion Severity Right - Severity of erosion on right bank. Site is shaded if value is Severe.

Bar Formation - Extent of bar formation in stream (Severe, Moderate, Mild, or None). Site is shaded if value is Severe

Table 4-1. (Continued)

Watershed Abbreviations

BACK	Back River
BIRD	Bird River
BRET	Breton Bay
CONO	Conococheague
DOUB	Double Pipe Creek
EAST	Eastern Bay
GUNP	Gunpowder River
JONE	Jones Falls
LANG	Langford Creek
LOCH	Loch Raven Reservoir
LOCR	Lower Chester River
LOGU	Lower Gunpowder Falls
LOPC	Lower Pocomoke
LTON	Little Tonoloway
MARS	Marsh Run
MICR	Middle Chester River
MPAX	Middle Patuxent River
NANT	Nanticoke River
PRLT	Potomac River Lower Tidal
PRMO	Potomac River Montgomery County
PRMT	Potomac River Middle Tidal
PRWA	Potomac River Washington County
RKGR	Rocky Gorge Dam
SAVA	Savage River
SOUT	South River
STCL	St. Clement's Bay
TONO	Tonoloway
TOWN	Town Creek
WEST	West River

Cover Type Abbreviations

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

MBSS Stream Waders - Volunteer Benthic Sampling Program

Introduction

Begun in 2000 as a component of the MBSS, Maryland Stream Waders is a statewide volunteer stream-monitoring program managed by DNR. Goals of Stream Waders are to:

- increase the density of sampling sites for use in stream and watershed assessments;
- improve stream stewardship ethics and encourage local action to improve watershed management;
- educate the local community about the relationship between land use and stream quality; and
- provide quality assured information on stream quality to state, local, and federal agencies, environmental organizations, and others.

Stream Waders data are intended for use in water quality reports (such as Maryland's biennial water quality report to Congress – the 305(b) Report), watershed restoration and protection programs, regulatory programs (such as 303(d) listing), and for local government use. They are also provided to the volunteers themselves who may have an interest in a particular stream or watershed.

Methods

Stream Waders is designed to be seamless with the MBSS and monitoring programs conducted by several other organizations, such as Montgomery County, who are sampling stream benthos in Maryland. MBSS samples are collected at the watershed level (8-digit), while Stream Waders volunteers sample at the subwatershed (12-digit) level. Thus, Stream Waders data should help "fill the gaps" left in watershed areas not sampled by MBSS.

Each year, local governments and citizen organizations interested in the selected watersheds (the same watersheds chosen to be sampled that year by the core MBSS) were invited to submit site locations to be sampled by Stream Waders volunteers. For 2002, about 95 sites were chosen by local government agencies and citizen organizations. These pre-selected sites, along with others chosen to support DNR-supported programs (e.g., Watershed Restoration Action Strategies) were prioritized over others. For subwatersheds with few or no pre-selected sites, volunteers were asked to distribute additional sites throughout the subwatershed, with one site near the most downstream portion of the catchment. Most sites were either upstream of a road crossing or within an easy walk of a road. Volunteers selected 100-foot sections of stream for their samples. Each team of volunteers was given a GPS unit to record the latitude and longitude of the actual sampling sites.

A total of 76 volunteers were trained at three eight-hour training sessions in February 2002. For 2002, 19 watersheds were slated for sampling. Each of the 24 volunteer teams that formed during the training sessions were asked to select four subwatersheds and to sample five sites within each subwatershed. Volunteers sampled during the 1 March to 30 April spring index period.

Benthic macroinvertebrates were sampled using the same methods as MBSS biologists (Boward 2001 and Kazyak 2001). Samples were preserved in ethanol and organisms were subsampled (about 100 organisms per sample) and identified to family (Boward and Friedman 2000) by DNR staff at DNR's laboratory in Annapolis. From the list of organisms identified from each site, a family-level Index of Biotic Integrity (IBI) was calculated and each site was rated either Good (IBI 4-5) Fair (IBI 3-3.9) or Poor (IBI 1-2.9) (Stribling et al. 1998).

In addition to sampling benthos at each site, volunteers noted general information about each stream, such as width and depth, as well as a description of the surrounding land and potential problems.

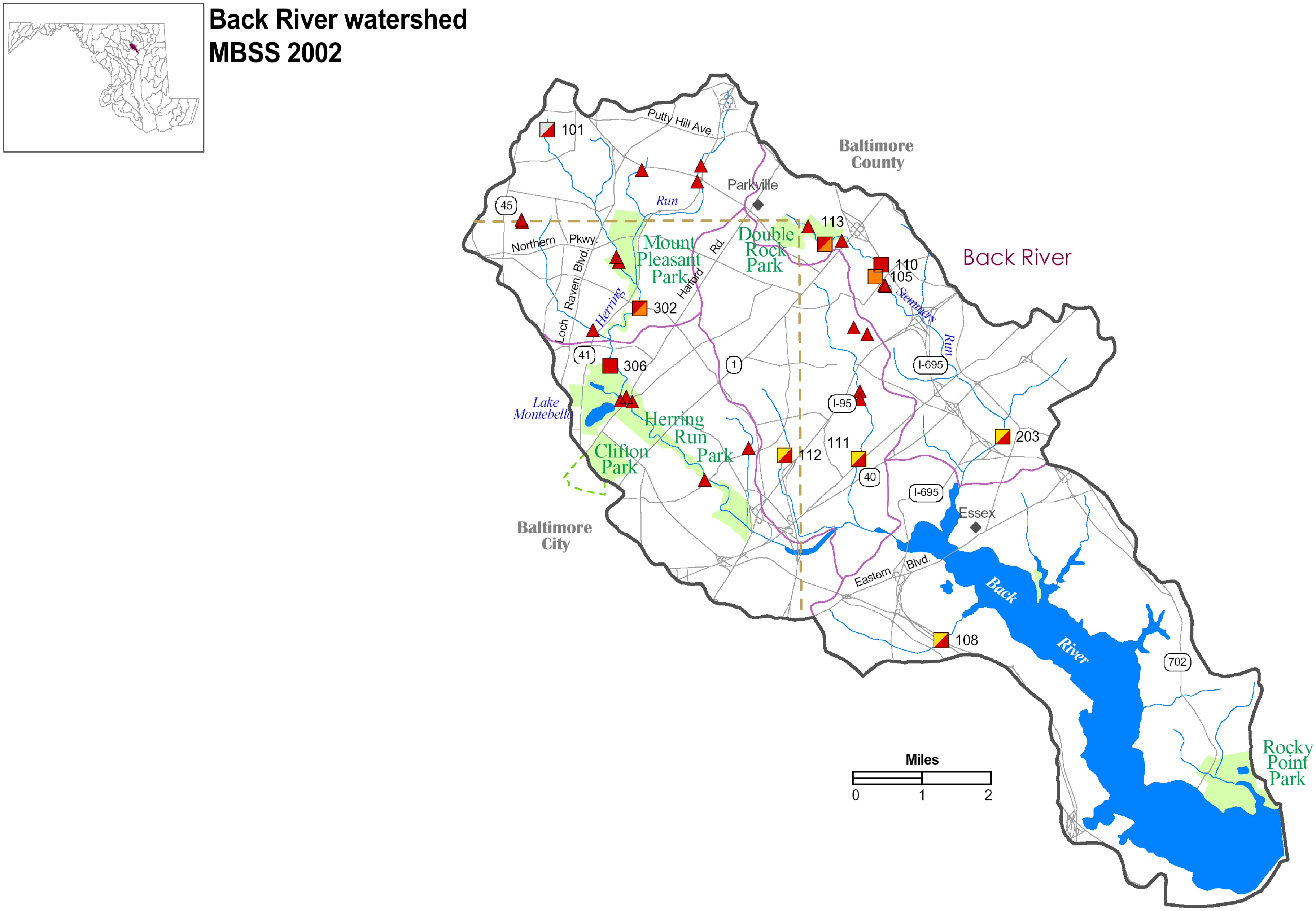
Results

In all, 298 sites in 12 12-digit watersheds were sampled during the 2002 Maryland Stream Waders Program. IBI results for these sites are included in the appropriate PSU summary located in this Chapter. A summary of stream waders results, by MBSS PSU, is included in the following table.

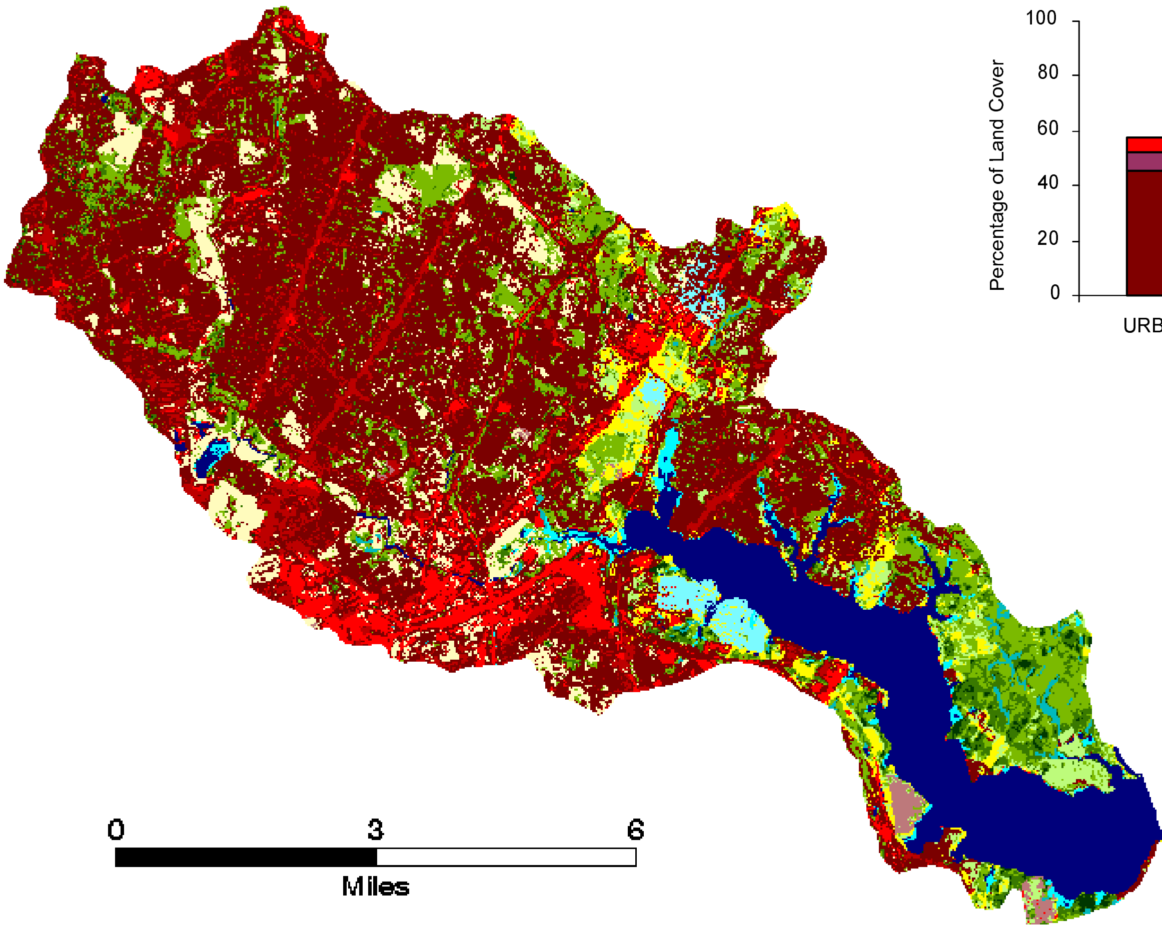
Summary of 2002 Stream Waders IBI Results

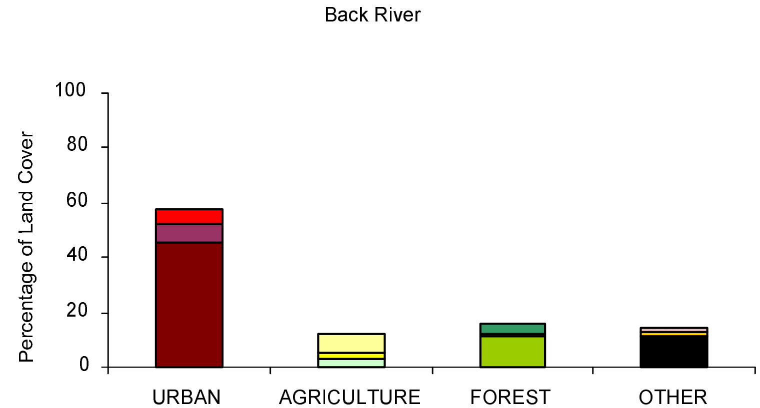
Primary Sampling Unit	Number of Stream Waders Sites	Summary
Back River	24	All sites were rated Very Poor. Stream Waders results generally agree with those of MBSS, where three sites were rated Poor and the remainder rated Very Poor.
Breton Bay/St. Clements Bay	40	Three fourths of all sites were rated either Good or Fair. Only three sites were rated Very Poor. Most Good sites were the upper portion of the watershed, especially in Burnt Mill Creek and St. Clements Creek. Stream Waders results compared well with those of MBSS samples.
Conococheaque Creek	16	Only one site was rated Fair. The remainder were rated either Poor or Very Poor. Stream Waders results compared well with those of MBSS samples.
Conewago/Double Pipe Creek	40	Only one site on a tributary tributary to Big Silver Run was rated Good. More than one half of all sites were rated either Poor or Very Poor. Results generally agree with those of MBSS, especially in a cluster of sites in the eastern portion of Big Pipe Creek.
Eastern Bay/Kent Narrows/ Lower Chester River/ Langford Creek/Kent Island Bay	20	One site, in the Kent Narrows watershed, was rated Good and one site was rated Fair. Fifteen sites were rated Very Poor. Clusters of MBSS and Stream Waders sites in the Kent Narrows and Langford Creek watersheds had comparable results.
Gunpowder River/Lower Gunpowder Falls/Bird River/ Middle River-Browns	5	All sites were rated either Poor or Very Poor. These findings compare well with those of MBSS, where only two of the 10 sites sampled were rated Fair, and the rest Poor or Very Poor.
Jones Falls	23	Although 19 sites were rated Very Poor or Poor, four sites were rated either Good or Fair. These sites were mostly in the northwestern portion of the watershed. Both MBSS and Stream Waders results show degraded stream conditions inside Baltimore City and in those streams that drain suburban Towson.
Lower Pocomoke River	26	Most sites were rated Poor or Very Poor. Only two were rated Fair and none were rated Good. Results compare well with those of MBSS, especially in a cluster of sites in the Corkers Creek watershed.
Middle Chester River	20	All sites were rated Poor or Very Poor. In several cases, Stream Waders results tended to rate streams as more degraded than MBSS results, as indicated by clusters of sites in the Morgan Creek watershed.
Middle Patuxent River	18	About half of the sites were rated Fair and half rated either Poor or Very Poor. No sites were rated Good. Although MBSS and Stream Waders results generally agree, disparate ratings were found at a series of sites along the upstream portion of the Middle Patuxent River.
Savage River	27	Most sites were rated Good. Only two sites were rated Poor or Very Poor. Most MBSS and Stream Waders sites in Savage River State Forest were rated Good.
South River/West River	43	Most sites were rated either Poor or Very Poor. Only two sites were rated Fair and none were rated Good. Stream Waders results compared well with those of MBSS.

Back River watershed
MBSS 2002



Back River


0
3
6
Miles


Back River
Percentage of Land Cover
100
80
60
40
20
0
URBAN
AGRICULTURE
FOREST
OTHER

Back River

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
BACK-101-R-2002	Herring Run Ut	021309011042	Back River	Patapsco River	Baltimore	6-Mar-02	4-Jun-02	1	123
BACK-105-R-2002	Stemmers Run	021309011039	Back River	Patapsco River	Baltimore	6-Mar-02	5-Jun-02	1	1733
BACK-108-R-2002	Bread And Cheese Cr	021309011038	Back River	Patapsco River	Baltimore	25-Mar-02	18-Jun-02	1	639
BACK-110-R-2002	Stemmers Run	021309011039	Back River	Patapsco River	Baltimore	6-Mar-02	5-Jun-02	1	1547
BACK-111-R-2002	Redhouse Cr	021309011040	Back River	Patapsco River	Baltimore	25-Mar-02	4-Jun-02	1	1877
BACK-112-R-2002	Moore's Run	021309011040	Back River	Patapsco River	Baltimore City	25-Mar-02	18-Jun-02	1	2514
BACK-113-R-2002	Stemmers Run	021309011039	Back River	Patapsco River	Baltimore	6-Mar-02	5-Jun-02	1	857
BACK-203-R-2002	Stemmers Run	021309011039	Back River	Patapsco River	Baltimore	25-Mar-02	10-Jun-02	2	5322
BACK-302-R-2002	Herring Run (PP)	021309011042	Back River	Patapsco River	Baltimore City	25-Mar-02	17-Jun-02	3	4774
BACK-306-R-2002	Herring Run (PP)	021309011041	Back River	Patapsco River	Baltimore City	6-Mar-02	10-Jun-02	3	7304

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
BACK-101-R-2002	NR	1.67	19.49	0	0
BACK-105-R-2002	2.11	2.33	25.14	0	0
BACK-108-R-2002	3.75	1.86	13.81	0	0
BACK-110-R-2002	1.44	1.67	12.01	0	0
BACK-111-R-2002	3.00	1.86	17.90	0	0
BACK-112-R-2002	3.25	1.57	21.74	0	0
BACK-113-R-2002	1.89	2.11	17.63	0	0
BACK-203-R-2002	3.75	1.86	9.53	0	0
BACK-302-R-2002	1.89	2.33	34.51	0	0
BACK-306-R-2002	1.67	1.67	5.36	0	0

Interpretation of Watershed Condition

- Highly urbanized watershed with high impervious surface at every site
- Nitrogen and Chloride concentrations high at most sites
- Many sites with buffer breaks, channelization and bar formation

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
BACK-101-R-2002	89.05	2.15	8.80	0.00	30.88
BACK-105-R-2002	63.91	17.46	18.59	0.04	19.26
BACK-108-R-2002	73.93	18.67	7.40	0.00	24.55
BACK-110-R-2002	63.33	17.34	19.29	0.04	19.34
BACK-111-R-2002	77.32	6.42	16.05	0.20	23.11
BACK-112-R-2002	86.95	4.41	8.57	0.08	27.29
BACK-113-R-2002	64.86	13.99	21.07	0.08	19.74
BACK-203-R-2002	59.55	17.52	21.00	1.93	19.79
BACK-302-R-2002	75.51	10.53	13.75	0.20	24.30
BACK-306-R-2002	78.96	8.13	12.78	0.13	25.65

Back River
Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
BACK-101-R-2002	7.40	359.2	1138.8	46.158	1.725	24.779	0.0251	0.0131	0.0090	0.0546	1.8185	1.5038	6.9	0.6
BACK-105-R-2002	8.32	772.3	1585.5	160.544	1.367	35.892	0.0191	0.0024	0.0082	0.0069	1.4171	3.5958	10.2	1.4
BACK-108-R-2002	8.15	577.3	1550.4	87.396	1.474	53.527	0.0243	0.0007	0.0097	0.0313	1.6671	2.8665	5.4	2.2
BACK-110-R-2002	8.52	705.3	1532.1	141.308	1.510	31.821	0.0348	0.0080	0.0106	0.0140	1.6130	3.5800	10.8	6.7
BACK-111-R-2002	7.91	562.5	1604.3	92.054	0.688	37.103	0.0131	0.0007	0.0067	0.0274	0.8791	3.0694	7	6.4
BACK-112-R-2002	7.92	526.9	1687.6	78.724	1.003	35.103	0.0203	0.0007	0.0142	0.0155	1.1767	3.0013	5.9	1.8
BACK-113-R-2002	7.91	416.6	1448.4	54.639	1.354	27.639	0.0147	0.0034	0.0043	0.0082	1.4301	4.0228	6.7	0.2
BACK-203-R-2002	7.52	657.3	1669.1	122.154	0.769	32.769	0.0176	0.0007	0.0062	0.0236	0.9461	2.7592	6.5	6.6
BACK-302-R-2002	7.90	556.8	1574.9	98.128	1.040	26.793	0.0120	0.0007	0.0111	0.0117	1.1922	3.2489	8.3	2
BACK-306-R-2002	8.12	537.0	1278.7	95.506	1.308	25.377	0.1820	0.1571	0.0124	0.0559	1.5982	3.1263	2.2	0

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
BACK-101-R-2002	50	20	LN	PK	10	13	7	7	51	11	29	40	90	7	32
BACK-105-R-2002	30	2	HO	LN	11	11	12	13	66	8	9	40	60	6	62
BACK-108-R-2002	0	0	PV	PV	5	3	7	11	75	0	0	100	99	1	59
BACK-110-R-2002	10	40	CP	PV	13	15	7	7	12	9	75	60	75	5	31
BACK-111-R-2002	50	4	LN	PK	6	6	8	7	72	7	6	65	88	6	47
BACK-112-R-2002	50	50	FR	FR	9	10	5	9	75	0	0	40	90	1	49
BACK-113-R-2002	50	50	HO	FR	14	15	7	7	20	8	65	40	90	10	32
BACK-203-R-2002	50	10	FR	PK	6	4	3	8	75	0	0	80	90	4	46
BACK-302-R-2002	40	15	PV	PV	10	12	14	11	47	14	35	30	60	2	111
BACK-306-R-2002	40	50	PV	FR	10	14	6	7	66	6	15	55	70	3	35

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
BACK-101-R-2002	Y	N	N	N	Moderate	Moderate	Severe
BACK-105-R-2002	Y	N	N	Y	Severe	Moderate	Severe
BACK-108-R-2002	Y	N	N	Y	None	Mild	Severe
BACK-110-R-2002	Y	N	N	Y	Moderate	Moderate	Severe
BACK-111-R-2002	Y	N	N	N	Moderate	Moderate	Severe
BACK-112-R-2002	N	N	N	N	Mild	Severe	Severe
BACK-113-R-2002	Y	N	N	Y	Moderate	Moderate	Severe
BACK-203-R-2002	N	N	N	N	Mild	Mild	Moderate
BACK-302-R-2002	Y	N	N	Y	Mild	Moderate	Severe
BACK-306-R-2002	Y	N	N	N	None	None	Severe

Back River

Fish Species Present

AMERICAN EEL
BANDED KILLIFISH
BLACKNOSE DACE
BLUNTNOSE MINNOW
CREEK CHUB
EASTERN SILVERY MINNOW
FATHEAD MINNOW
GOLDEN SHINER
GOLDFISH
MOSQUITOFISH
MUMMICHOG
PUMPKINSEED
REDBREAST SUNFISH
SATINFIN SHINER
SPOTTAIL SHINER
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
PHRAGMITES

Benthic Taxa Present

ABLABESMYIA
AMPHINEMURA
ANTOCHA
ARGIA
CAECIDOTEA
CALOPTERYX
CERATOPOGONIDAE
CHEUMATOPSYCHE
CHIRONOMIDAE
CHIRONOMINAE
CHIRONOMINI
CHIRONOMUS
CONCHAPELOPIA
CRANGONYX
CRICOTOPUS
CRYPTOCHIRONOMUS
CURCULIONIDAE
DICROTENDIPES
DUGESIA
ENALLAGMA
ENCHYTRAEIDAE
EUKIEFFERIELLA
GASTROPODA
GLOSSIPHONIIDAE
GORDIIDAE
HEMERODROMIA
HYDROBAENUS
HYDROPSYCHE
HYDROPSYCHIDAE
LIMNODRILUS
LIMNOPHILA
LIMNOPHYES
LUMBRICULIDAE
MENETUS
MEROPELOPIA
MICROPSECTRA
NAIDIDAE
NANOCLADIUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARAMETRIOCNEMUS
PARATANYTARSUS
PHAENOPSECTRA
PHYSELLA
POLYPEDILUM
PSYCHODA
SIMULIIDAE
SPHAERIUM
STAGNICOLA
STYGONECTES
SUBLETTEA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TUBIFICIDAE
ZAVRELIMYIA

Herpetofauna Present

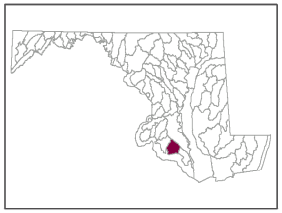
BULLFROG
GREEN FROG
NORTHERN TWO-LINED SALAMANDER

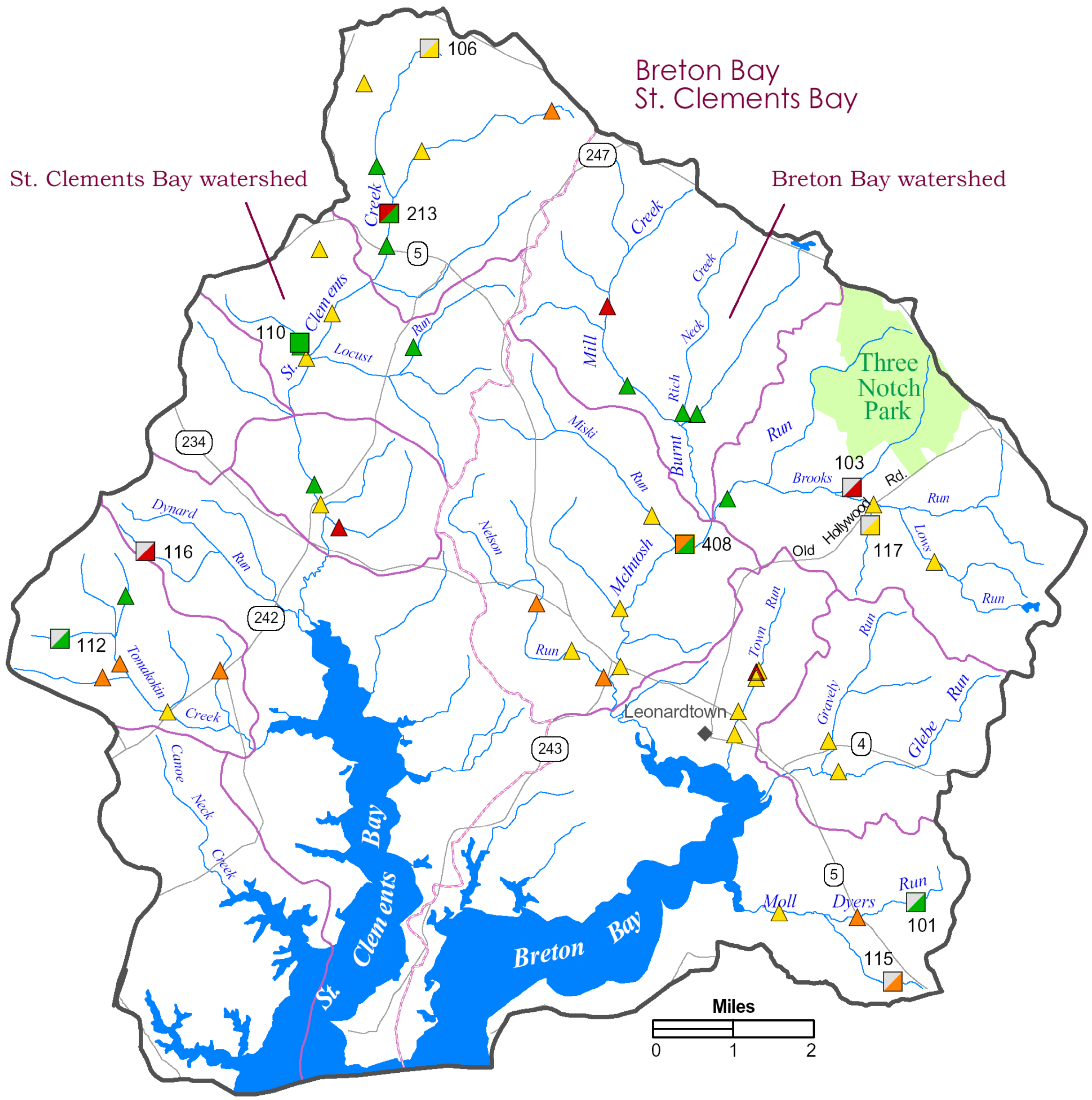
Back River

Stream Waders Data

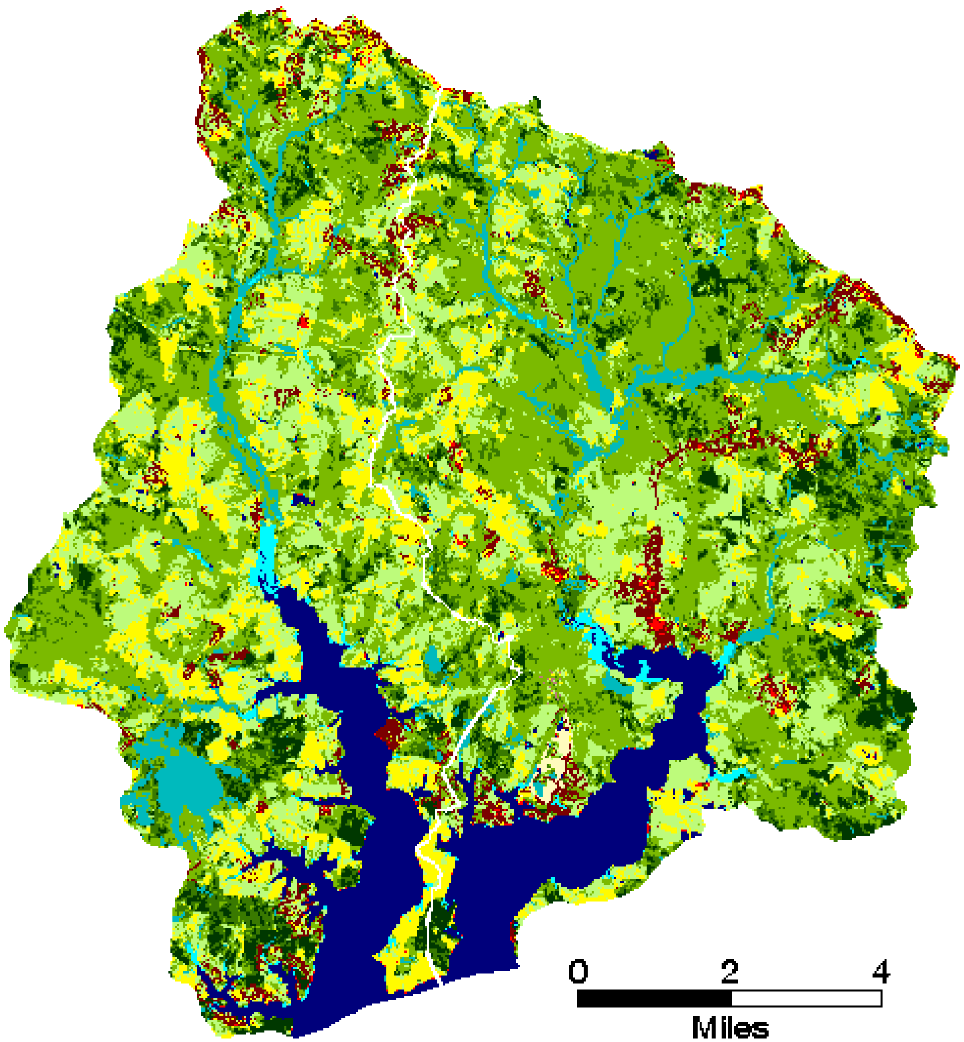
Site	8-Digit Watershed	Stream Name	Benthic IBI
1040-4	Back River	Redhouse Creek UT	1.57
1042-3	Back River	Walker Run	1.57
1039-2	Back River	Stemmers Run UT	1.00
1039-3	Back River	Stemmers Run	1.00
1039-92	Back River	Stemmers Run	1.29
1039-93	Back River	Stemmers Run	1.29
1040-1	Back River	Redhouse Creek	1.00
1040-2	Back River	Redhouse Creek UT	1.00
1040-3	Back River	Redhouse Creek	
1040-91	Back River	Redhouse Creek	1.29
1040-94	Back River	Redhouse Creek UT	1.57
1041-1	Back River	Herring Run	1.29
1041-2	Back River	Castle Run	1.00
1041-3	Back River	Biddison Run	1.57
1041-4	Back River	Herring Run	1.29
1041-9	Back River	Herring Run UT	1.57
1042-1	Back River	Chinquipin Run	
1042-2	Back River	Herring Run West Branch	1.29
1042-4	Back River	Herring Run UT	1.29
1042-5	Back River	Herring Run East Branch	1.29
1042-91	Back River	Chinquipin Run	1.00
1042-92	Back River	Herring Run West Branch	1.29
1042-93	Back River	Walker Run	1.29
1042-95	Back River	Herring Run East Branch	1.29

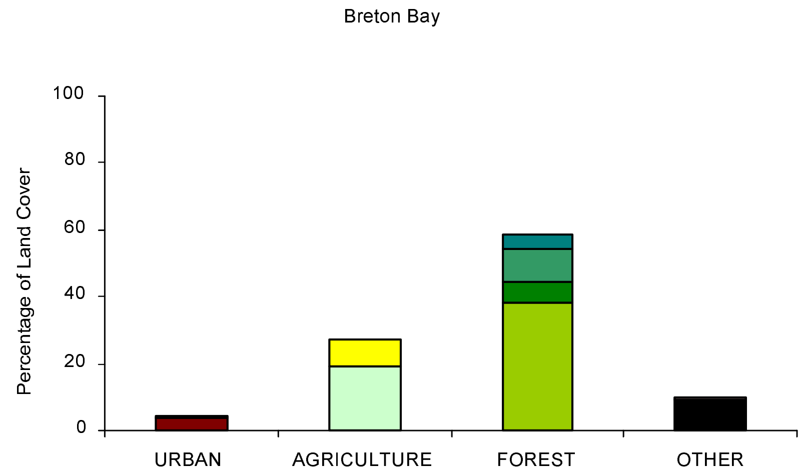
Breton Bay/
St. Clements Bay wat
MBSS 2002

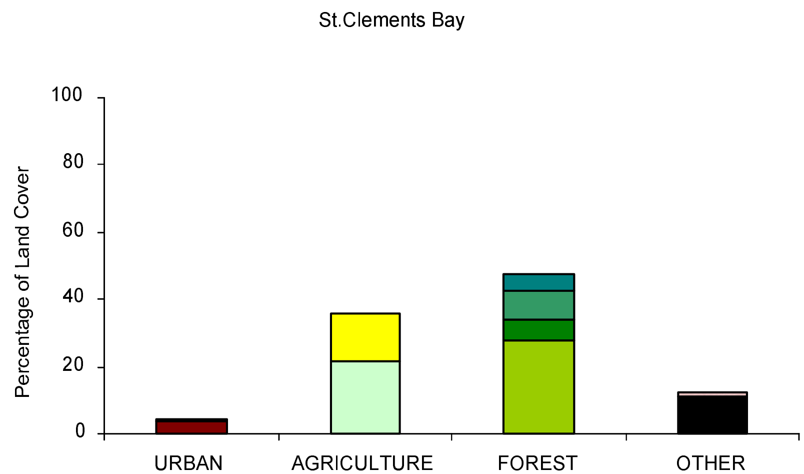




Breton/St. Clements Bays







Breton/St. Clements Bays

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
BRET-101-R-2002	Moll Dyers Run	021401040720	Breton Bay	Lower Potomac River	St. Marys	11-Mar-02	24-Jun-02	1	289
BRET-103-R-2002	Brooks Run Ut 1	021401040723	Breton Bay	Lower Potomac River	St. Marys	12-Mar-02	24-Jun-02	1	936
BRET-115-R-2002	Moll Dyers Run Ut	021401040720	Breton Bay	Lower Potomac River	St. Marys	11-Mar-02	26-Jun-02	1	79
BRET-117-R-2002	Brooks Run Ut 2	021401040723	Breton Bay	Lower Potomac River	St. Marys	19-Mar-02	24-Jun-02	1	403
BRET-408-R-2002	Macintosh Run	021401040721	Breton Bay	Lower Potomac River	St. Marys	12-Mar-02	2-Jul-02	4	14509
STCL-106-R-2002	St Clements Cr	021401050731	St. Clement Bay	Lower Potomac River	St. Marys	12-Mar-02	24-Jun-02	1	192
STCL-110-R-2002	St Clements Cr Ut 1	021401050730	St. Clement Bay	Lower Potomac River	St. Marys	13-Mar-02	24-Jun-02	1	578
STCL-112-R-2002	Tomakokin Cr Ut	021401050727	St. Clement Bay	Lower Potomac River	St. Marys	13-Mar-02	26-Jun-02	1	99
STCL-116-R-2002	Dynard Run Ut	021401050726	St. Clement Bay	Lower Potomac River	St. Marys	13-Mar-02	26-Jun-02	1	79
STCL-213-R-2002	St Clements Cr	021401050731	St. Clement Bay	Lower Potomac River	St. Marys	12-Mar-02	2-Jul-02	2	3812

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
BRET-101-R-2002	NR	4.14	57.83	0	0
BRET-103-R-2002	NS	1.57	NS	NS	NS
BRET-115-R-2002	NS	2.71	NS	NS	NS
BRET-117-R-2002	NS	3.00	NS	NS	NS
BRET-408-R-2002	2.50	4.71	86.63	0	0
STCL-051-S-2002	NS	4.71	52.39	0	0
STCL-106-R-2002	NS	3.29	NS	NS	NS
STCL-110-R-2002	4.00	4.14	80.49	0	0
STCL-112-R-2002	NS	4.71	52.94	0	0
STCL-116-R-2002	NS	1.86	19.06	0	0
STCL-213-R-2002	1.50	4.14	4.27	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
BRET-101-R-2002	0.00	5.60	94.40	0.00	0.00
BRET-103-R-2002	8.32	17.55	72.32	1.81	2.31
BRET-115-R-2002	2.54	12.99	84.46	0.00	1.34
BRET-117-R-2002	16.39	16.06	67.55	0.00	4.54
BRET-408-R-2002	4.91	20.96	72.72	1.41	1.49
STCL-051-S-2002	0.13	24.80	74.93	0.13	0.49
STCL-106-R-2002	19.16	41.58	39.26	0.00	6.88
STCL-110-R-2002	0.12	39.50	60.19	0.19	0.03
STCL-112-R-2002	0.00	12.44	87.56	0.00	0.00
STCL-116-R-2002	0.00	55.87	44.13	0.00	0.00
STCL-213-R-2002	10.04	24.90	64.94	0.12	3.16

Interpretation of Watershed Condition

- Several sites with low ANC values
- Total phosphorus elevated at many sites
- Two sites highly turbid

Breton/St. Clements Bays

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
BRET-103-R-2002	6.09	90.4	144.7	12.909	0.047	11.574	0.0190	0.0007	0.0004	0.0164	0.1566	2.7015	NS	NS
BRET-115-R-2002	5.32	90.1	33.3	18.133	0.001	7.074	0.0210	0.0007	0.0014	0.0108	0.1269	3.6199	NS	NS
BRET-117-R-2002	6.06	89.5	78.3	15.150	0.090	10.042	0.0141	0.0007	0.0016	0.0411	0.2302	3.0153	NS	NS
BRET-408-R-2002	7.33	121.0	612.9	10.172	0.200	8.195	0.0330	0.0054	0.0046	0.0278	0.3377	4.4406	2.6	17.8
STCL-106-R-2002	6.86	115.6	326.2	12.493	1.044	10.067	0.0256	0.0025	0.0057	0.0302	1.1588	3.1170	NS	NS
STCL-110-R-2002	7.08	84.3	432.0	5.920	0.160	6.137	0.0318	0.0085	0.0048	0.0154	0.3119	4.3352	6.8	3.1
STCL-112-R-2002	6.31	39.0	87.8	5.239	0.374	2.142	0.0164	0.0111	0.0041	0.0169	0.5366	4.7520	5.4	2.4
STCL-116-R-2002	6.91	140.5	690.4	11.714	0.144	11.826	0.0736	0.0202	0.0035	0.0124	0.2877	4.2636	2.3	8.9
STCL-213-R-2002	6.95	105.3	569.7	7.330	0.100	6.638	0.0453	0.0048	0.0049	0.0242	0.2253	3.4001	4.3	52.2

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
BRET-101-R-2002	15	50	DI	FR	14	16	7	9	43	9	32	30	94	16	39
BRET-103-R-2002	45	50	CR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	18	NS
BRET-115-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
BRET-117-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	8	NS
BRET-408-R-2002	50	50	FR	OF	14	10	10	15	71	6	4	39	99	17	94
STCL-106-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	11	NS
STCL-110-R-2002	50	50	FR	FR	15	15	12	14	54	7	21	60	97	17	54
STCL-112-R-2002	50	50	FR	FR	14	15	5	10	59	6	16	40	98	17	36
STCL-116-R-2002	50	40	FR	CP	10	7	2	7	74	0	0	70	90	15	34
STCL-213-R-2002	50	50	LN	FR	2	3	1	3	8	0	0	100	92	16	38

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
BRET-101-R-2002	Y	N	N	N	Severe	Mild	Moderate
BRET-103-R-2002	N	N	N	N	NS	NS	NS
BRET-115-R-2002	N	N	N	N	NS	NS	NS
BRET-117-R-2002	N	N	N	N	NS	NS	NS
BRET-408-R-2002	N	N	N	N	Moderate	Moderate	Moderate
STCL-051-S-2002	N	N	N	N	Mild	Mild	Moderate
STCL-106-R-2002	N	N	N	N	NS	NS	NS
STCL-110-R-2002	N	N	N	N	Mild	Mild	Severe
STCL-112-R-2002	N	N	N	N	Mild	Mild	Moderate
STCL-116-R-2002	Y	N	N	N	Moderate	Moderate	Moderate
STCL-213-R-2002	N	N	N	N	None	None	None

Breton/St. Clements Bays

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
LEAST BROOK LAMPREY
MARGINED MADTOM
PIRATE PERCH
REDBREAST SUNFISH
TESSELLATED DARTER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
AGABUS
AMELETUS
AMPHINEMURA
AMPHIPODA
ANCHYTARSUS
APSECTROTANYPUS
BITTACOMORPHA
BOYERIA
CAECIDOTEA
CERATOPOGON
CERATOPOGONIDAE
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINI
CHLOROPERLIDAE
CHRYSOPS
CLIOPERLA
CONCHAPELOPIA
CORDULEGASTER
CORDULIIDAE
CORIXIDAE
CORYNONEURA
CRANGONYX
CRICOTOPUS
CULTUS
DINEUTUS
DIPLECTRONA
DIPLOCLADIUS
DIPLOPERLA
DOLOPHILODES
DUBIRAPHIA
ECCOPTURA
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GAMMARUS
GOMPHUS
GYRINUS
HEMERODROMIA
HEPTAGENIIDAE
HETEROPLECTRON
HETEROTRISSOCLADIUS
HEXATOMA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
HYDROPSYCHIDAE
IRONOQUIA
ISOPERLA
ISOTOMURUS
LABRUNDINIA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCTRA
LEUCTRIDAE
LIMNEPHILIDAE
LIMNEPHILUS
LUMBRICULIDAE
MACRONYCHUS
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MUSCULIUM
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
NEOPHYLAX
NIGRONIA
OECETIS
OLIGOCHAETA
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
OXYETHIRA
PARACAPNIA
PARACHIRONOMUS
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PARATENDIPES
PERLODIDAE
PHAENOPSECTRA
PHYLOCENTROPUS
PHYSELLA
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROSIMULIUM
PSEPHENUS
PSEUDOLIMNOPHILA
PTILOSTOMIS
PYCNOPSYCHE
RHEOTANYTARSUS
RHYACOPHILA
SIALIS
SIMULIUM
SIPHLOPLECTRON
SOMATOCHLORA
SPHAERIIDAE
SPHAERIUM
STAGNICOLA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENONEMA
STYGONECTES
SYMPOSIOCLADIUS
SYNURELLA
TABANUS
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
TIPULA
TIPULIDAE
TRIAENODES
TRIBELOS
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
UNNIELLA
ZAVRELIMYIA

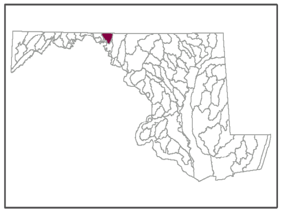
Herpetofauna Present

AMERICAN TOAD
EASTERN BOX TURTLE
FOWLER'S TOAD
GRAY TREEFROG
GREEN FROG
NORTHERN SPRING PEEPER
NORTHERN TWO-LINED SALAMANDER
PICKEREL FROG
PSEUDOTRITON SP.
SOUTHERN LEOPARD FROG
WOOD FROG

Breton/St. Clements Bays

Stream Waders Data

Site	8-Digit Watershed	Stream Name	Benthic IBI
720-3	Breton Bay	Town Run UT	1.57
720-1	Breton Bay	Town Run	3.86
720-2	Breton Bay	Town Run	3.86
720-4	Breton Bay	Moll Dyers Run	3.57
720-5	Breton Bay	Moll Dyers Run	2.14
720-6	Breton Bay	Town Run	3.00
720-7	Breton Bay	Town Run	3.29
721-1	Breton Bay	Nelson Run	3.00
721-2	Breton Bay	Nelson Run	2.71
721-3	Breton Bay	McIntosh Run	3.00
721-4	Breton Bay	Greenhill Run	3.57
721-5	Breton Bay	Nelson Run	2.14
721-6	Breton Bay	Miski Run	3.29
722-1	Breton Bay	Glebe Run	3.29
722-2	Breton Bay	Gravely Run	3.57
723-1	Breton Bay	McIntosh Run	4.14
723-2	Breton Bay	Brooks Run	3.29
723-3	Breton Bay	Lows Run	3.29
724-2	Breton Bay	Tom Swamp Run	4.14
724-3	Breton Bay	Rich Neck Creek	4.71
724-4	Breton Bay	Burnt Mill Creek	4.14
724-5	Breton Bay	Burnt Mill Creek	1.57
727-1	St. Clements Bay	Tamakokin Creek UT	2.14
727-2	St. Clements Bay	Tamakokin Creek	2.71
727-3	St. Clements Bay	Tamakokin Creek	3.86
727-4	St. Clements Bay	Tamakokin Creek UT	4.14
727-5	St. Clements Bay	Tamakokin Creek UT	2.43
728-1	St. Clements Bay	Saint Clements Creek	4.43
728-2	St. Clements Bay	Saint Clements Creek	3.57
728-3	St. Clements Bay	Saint Clements Creek UT	1.29
730-1	St. Clements Bay	Saint Clements Creek	3.29
730-2	St. Clements Bay	Saint Clements Creek UT	5.00
730-3	St. Clements Bay	Saint Clements Creek	3.57
730-4	St. Clements Bay	Saint Clements Creek	3.00
730-5	St. Clements Bay	Locust Run	4.43
731-1	St. Clements Bay	Saint Clements Creek UT	2.71
731-2	St. Clements Bay	Saint Clements Creek UT	3.29
731-3	St. Clements Bay	Saint Clements Creek	4.14
731-4	St. Clements Bay	Saint Clements Creek	5.00
731-5	St. Clements Bay	Saint Clements Creek	3.86



Conococheague Creek watershed
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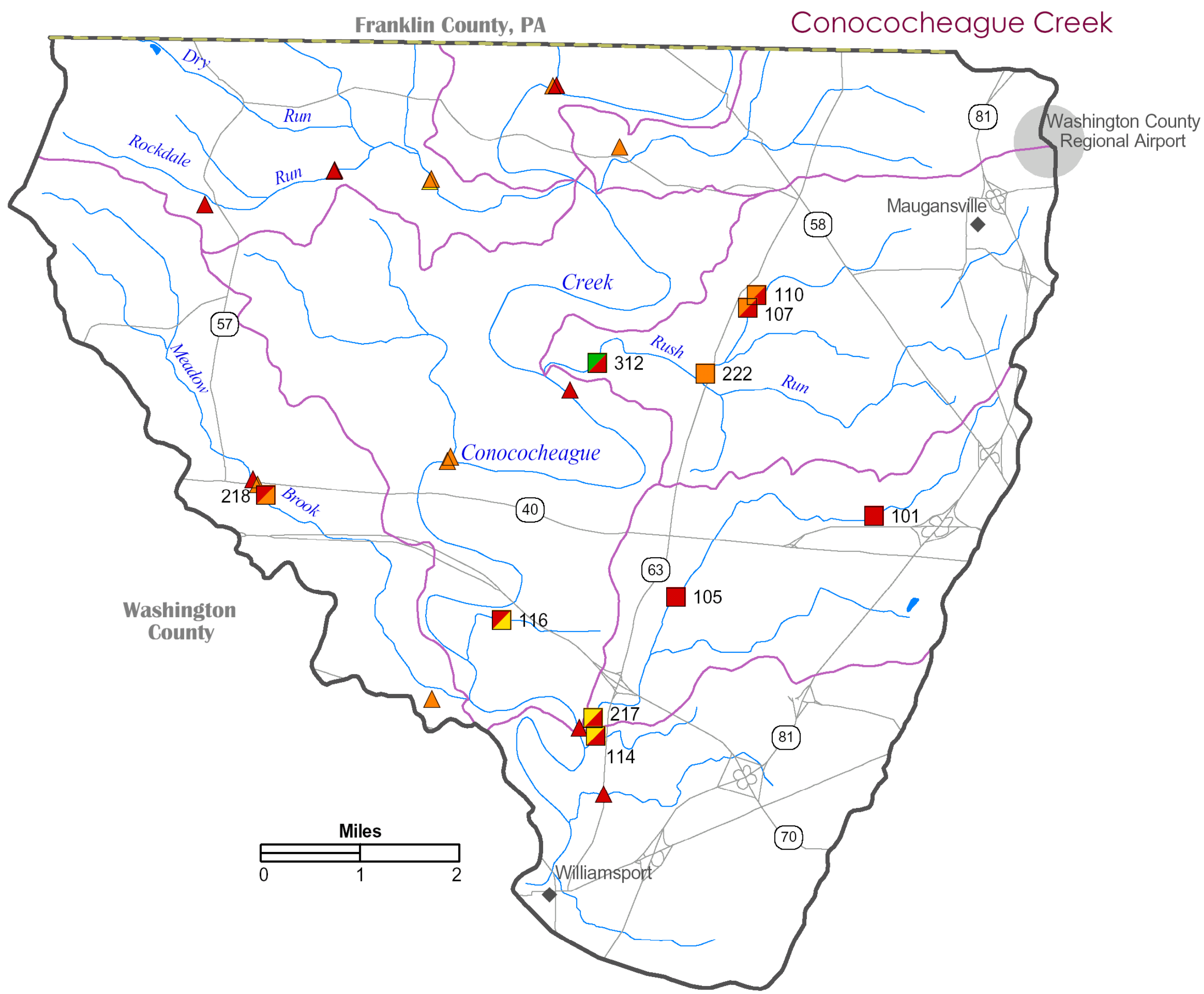
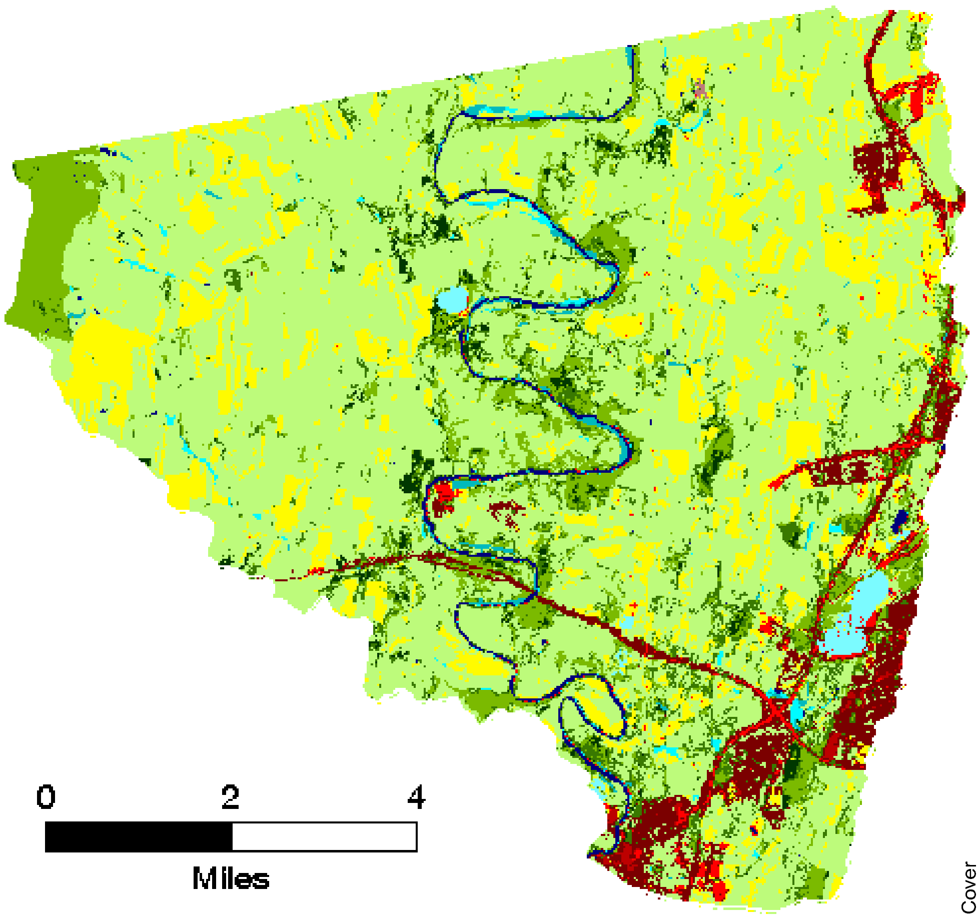
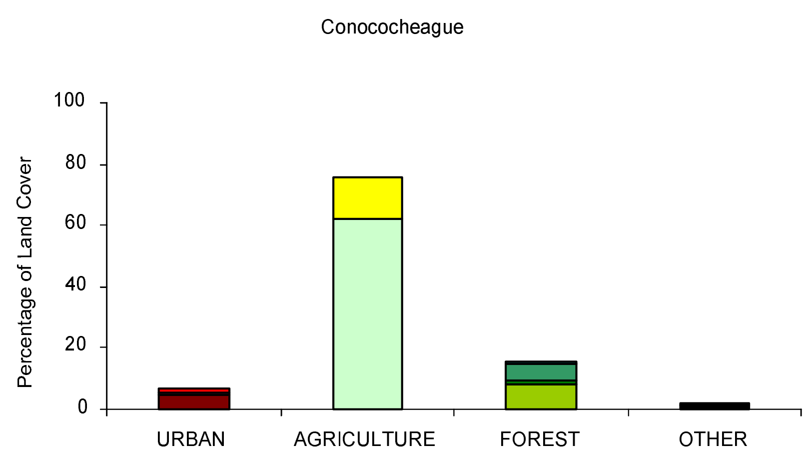


Conococheague





Conococheague

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
CONO-101-R-2002	Conococheague Cr Ut 2	021405040178	Conococheague	Upper Potomac River	Washington	19-Mar-02	7-Aug-02	1	936
CONO-105-R-2002	Conococheague Cr Ut 2	021405040178	Conococheague	Upper Potomac River	Washington	19-Mar-02	7-Aug-02	1	2592
CONO-107-R-2002	Troupe Run	021405040181	Conococheague	Upper Potomac River	Washington	19-Mar-02	13-Jun-02	1	1903
CONO-110-R-2002	Troupe Run	021405040181	Conococheague	Upper Potomac River	Washington	19-Mar-02	13-Jun-02	1	1858
CONO-114-R-2002	Conococheague Cr Ut 1	021405040177	Conococheague	Upper Potomac River	Washington	19-Mar-02	7-Aug-02	1	438
CONO-116-R-2002	Conococheague Cr Ut 3	021405040179	Conococheague	Upper Potomac River	Washington	7-Mar-02	7-Aug-02	1	587
CONO-217-R-2002	Conococheague Cr Ut 2	021405040178	Conococheague	Upper Potomac River	Washington	19-Mar-02	7-Aug-02	2	5002
CONO-218-R-2002	Meadow Br	021405040180	Conococheague	Upper Potomac River	Washington	25-Mar-02	9-Jul-02	2	3291
CONO-222-R-2002	Troupe Run	021405040181	Conococheague	Upper Potomac River	Washington	25-Mar-02	26-Jun-02	2	2618
CONO-312-R-2002	Rush Run	021405040181	Conococheague	Upper Potomac River	Washington	25-Mar-02	9-Jul-02	3	6485

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
CONO-101-R-2002	1.29	1.44	52.91	0	0
CONO-105-R-2002	1.00	1.44	16.76	0	0
CONO-107-R-2002	2.14	1.67	17.93	0	0
CONO-110-R-2002	2.43	1.67	14.34	0	0
CONO-114-R-2002	3.86	1.44	72.63	0	0
CONO-116-R-2002	1.00	3.44	1.95	0	0
CONO-217-R-2002	3.57	1.89	50.35	0	0
CONO-218-R-2002	1.00	2.33	2.12	0	0
CONO-222-R-2002	2.43	2.56	24.76		
CONO-312-R-2002	4.14	1.67	96.68	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
CONO-101-R-2002	23.48	58.81	17.57	0.14	13.63
CONO-105-R-2002	11.66	75.59	12.68	0.08	6.47
CONO-107-R-2002	5.77	91.94	2.14	0.15	2.86
CONO-110-R-2002	5.89	91.77	2.19	0.16	2.92
CONO-114-R-2002	4.45	60.99	33.65	0.91	3.28
CONO-116-R-2002	5.32	75.47	19.07	0.15	3.99
CONO-217-R-2002	11.19	71.33	15.97	1.51	6.48
CONO-218-R-2002	0.06	87.70	11.40	0.84	0.05
CONO-222-R-2002	1.82	96.67	1.38	0.13	0.83
CONO-312-R-2002	5.75	89.54	4.58	0.13	3.19

Interpretation of Watershed Condition

- Highly agricultural watershed; Site 101 has > 10% impervious surface
- Chloride, nitrogen and phosphorus high at most sites
- Turbidity high at several sites
- Several sites with no riparian buffer

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (μeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
CONO-101-R-2002	8.11	771.5	4303.6	69.227	5.194	39.183	0.0502	0.0054	0.0202	0.0371	5.1735	2.4786	8.3	34.2
CONO-105-R-2002	8.21	761.8	5233.8	58.116	4.618	35.870	0.3513	0.1433	0.1110	0.3109	6.0703	4.9053	5.4	183
CONO-107-R-2002	8.36	791.0	3510.4	101.548	5.737	42.071	0.1143	0.0086	0.0481	0.0057	5.9343	4.7870	7.6	6.1
CONO-110-R-2002	8.40	776.4	3458.1	100.401	5.712	41.610	0.1383	0.0101	0.0472	0.0087	5.8204	3.9948	7.6	6.1
CONO-114-R-2002	7.77	844.8	5233.8	71.657	4.038	52.804	0.0160	0.0060	0.0034	0.0157	4.0034	1.6095	9.8	4
CONO-116-R-2002	7.99	898.8	1685.1	129.886	0.333	135.137	0.0134	0.0007	0.0021	0.0128	0.5273	3.8953	4.9	4.8
CONO-217-R-2002	8.18	905.1	5228.1	92.811	4.367	41.991	0.0902	0.0437	0.0060	0.0126	4.4600	2.0338	9.6	42.8
CONO-218-R-2002	8.13	803.6	4869.0	70.855	6.336	25.894	0.0530	0.0007	0.0153	0.0435	6.3717	2.4955	4.9	249
CONO-222-R-2002	8.18	957.1	4934.4	87.072	11.359	44.094	0.1284	0.0099	0.0359	0.0883	12.1293	5.0553	8.4	7.1
CONO-312-R-2002	8.13	835.6	4445.2	76.290	7.948	38.224	0.0428	0.0040	0.0292	0.0766	7.9965	2.6832	9.2	19.8

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
CONO-101-R-2002	50	10	FR	CP	11	5	6	4	45	11	45	55	92	13	18
CONO-105-R-2002	50	50	OF	OF	6	4	8	7	13	13	65	75	30	16	26
CONO-107-R-2002	0	0	PA	PA	12	3	8	9	55	14	24	85	25	9	34
CONO-110-R-2002	0	0	PA	PA	8	3	8	6	70	14	5	80	10	13	28
CONO-114-R-2002	50	50	LN	OF	15	10	12	12	21	16	58	75	60	13	54
CONO-116-R-2002	50	50	FR	FR	3	12	2	2	18	0	0	20	97	18	7
CONO-217-R-2002	50	50	FR	LN	12	10	10	10	33	16	45	80	85	15	36
CONO-218-R-2002	0	0	PA	PA	2	1	4	3	45	6	35	90	15	11	12
CONO-222-R-2002	50	50	LN	LN	9	5	8	10	60	11	30	65	83	13	32
CONO-312-R-2002	50	50	FR	FR	16	7	15	13	40	17	42	30	75	16	52

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
CONO-101-R-2002	N	N	N	N	None	None	Moderate
CONO-105-R-2002	N	N	N	N	None	None	Severe
CONO-107-R-2002	Y	N	N	N	Moderate	Mild	None
CONO-110-R-2002	Y	N	N	N	Mild	Mild	None
CONO-114-R-2002	N	N	N	N	Mild	Mild	None
CONO-116-R-2002	N	N	N	N	None	None	Mild
CONO-217-R-2002	N	N	N	Y	None	None	None
CONO-218-R-2002	Y	N	N	N	Severe	Severe	Mild
CONO-222-R-2002	N	N	N	N	Severe	Moderate	Mild
CONO-312-R-2002	N	N	N	N	None	None	None

Conococheague

Fish Species Present

BLACKNOSE DACE
BLUNTNOSE MINNOW
COMMON SHINER
CREEK CHUB
FALLFISH
GOLDFISH
GREEN SUNFISH
LONGNOSE DACE
NONE
PEARL DACE
POTOMAC SCULPIN
PUMPKINSEED
RIVER CHUB
ROCK BASS
SPOTFIN SHINER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

AMPHINEMURA
AMPHIPODA
ANTOCHA
BAETIDAE
BAETIS
BEZZIA
CAECIDOTEA
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CLIOPERLA
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRYPTOCHIRONOMUS
CURA
DIAMESA
DIXA
DUGESIA
ELMIDAE
ENCHYTRAEIDAE
ENOCHRUS
EUKIEFFERIELLA
EURYLOPHELLA
GAMMARUS
GASTROPODA
GORDIIDAE
HYDROBAENUS
HYDROPHILIDAE
HYDROPSYCHE
HYDROPSYCHIDAE
ISOTOMIDAE
ISOTOMURUS
LACCOPHILUS
LIMNODRILUS
LIMNOPHYES
LIRCEUS
LUMBRICULIDAE
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NEOPHYLAX
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARACAPNIA
PARAKIEFFERIELLA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATENDIPES
PHYSELLA
POLYPEDILUM
PROBEZZIA
PROSIMULIUM
PSEPHENUS
PSEUDOLIMNOPHILA
SIMULIUM
SPHAERIIDAE
SPHAERIUM
STEGOPTERNA
STENELMIS
SUBLETTEA
SYMPOTTHASTIA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRICHOCORIXA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

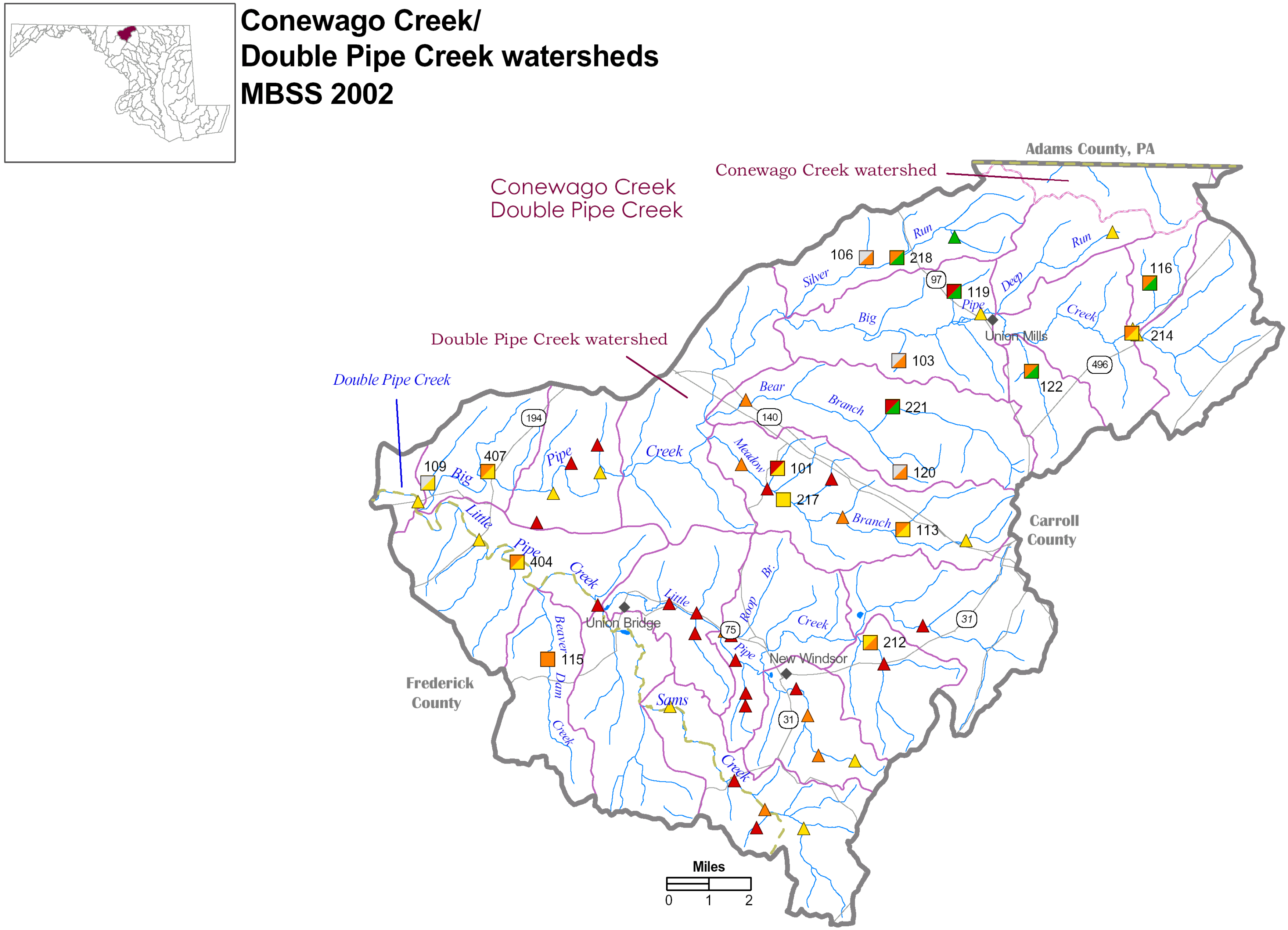
COMMON SNAPPING TURTLE
EASTERN PAINTED TURTLE
NORTHERN WATER SNAKE
PICKEREL FROG

Conococheague

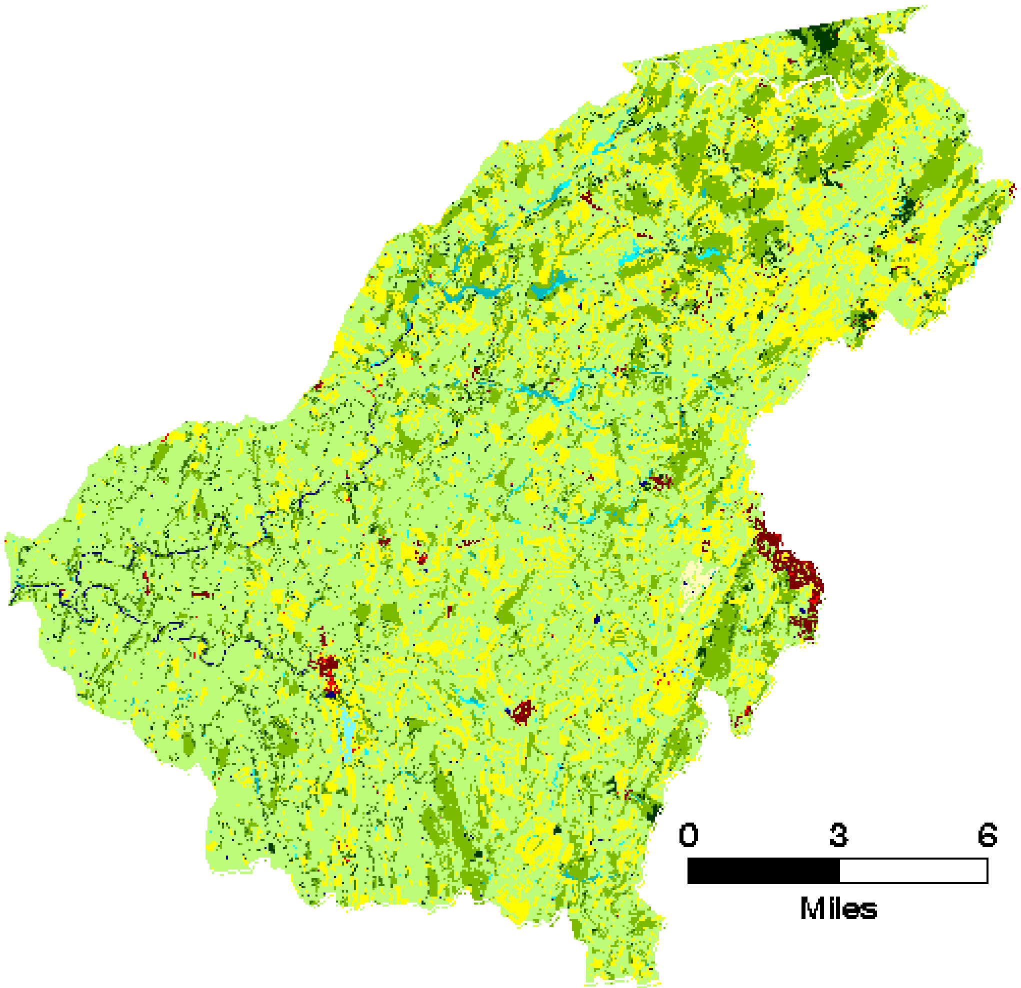
Stream Waders Data

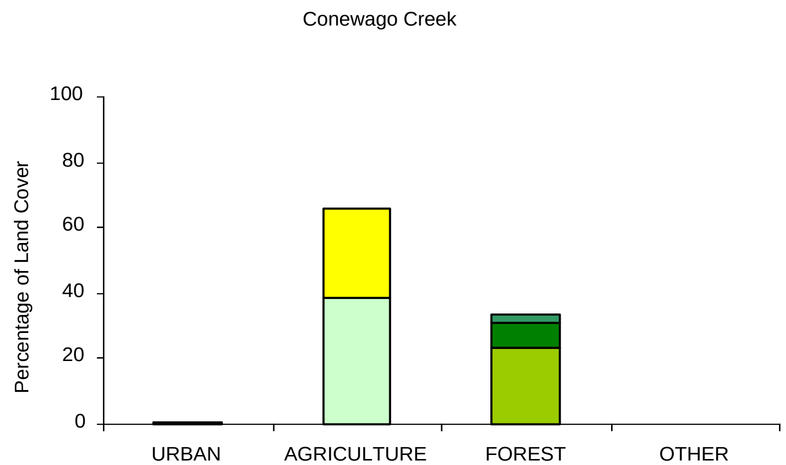
Site	8-Digit Watershed	Stream Name	Benthic IBI
177-6	Conococheague Creek	Semple Run	1.29
178-6	Conococheague Creek	Conococheague Creek UT	1.29
179-1	Conococheague Creek	Conococheague Creek UT	2.71
179-91	Conococheague Creek	Conococheague Creek UT	2.71
180-1	Conococheague Creek	Meadow Brook	2.43
180-2	Conococheague Creek	Meadow Brook	1.57
180-92	Conococheague Creek	Meadow Brook	2.14
181-6	Conococheague Creek	Rush Run	1.57
182-6	Conococheague Creek	Tom's Run	2.14
183-1	Conococheague Creek	Conococheague Creek UT	2.43
183-91	Conococheague Creek	Conococheague Creek UT	1.57
184-1	Conococheague Creek	Rockdale Run	2.43
184-2	Conococheague Creek	Rockdale Run	1.00
184-3	Conococheague Creek	Rockdale Run	1.29
184-91	Conococheague Creek	Rockdale Run	3.00
184-93	Conococheague Creek	Rockdale Run	1.29

Conewago Creek/
Double Pipe Creek watersheds
MBSS 2002

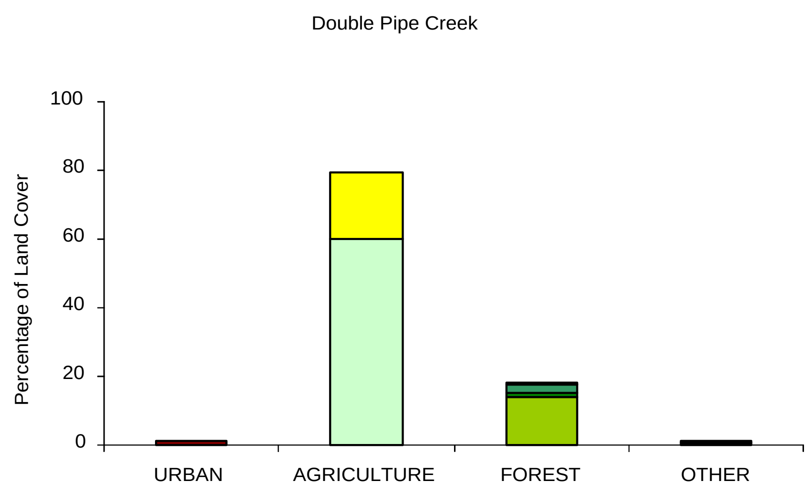


Conewago Creek/Double Pipe Creek





Conewago Creek/Double Pipe Creek



Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
DOUB-101-R-2002	Meadow Br Ut 1	021403040277	Double Pipe Creek	Middle Potomac	Carroll	4-Mar-02	18-Jul-02	1	408
DOUB-103-R-2002	Big Pipe Cr Ut 7	021403040283	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	10-Jul-02	1	168
DOUB-106-R-2002	Big Silver Run Ut	021403040285	Double Pipe Creek	Middle Potomac	Carroll	6-Mar-02	10-Jul-02	1	294
DOUB-109-R-2002	Big Pipe Cr Ut 6	021403040280	Double Pipe Creek	Middle Potomac	Carroll	4-Mar-02	18-Jul-02	1	1036
DOUB-113-R-2002	Meadow Br Ut	021403040277	Double Pipe Creek	Middle Potomac	Carroll	6-Mar-02	22-Jul-02	1	885
DOUB-115-R-2002	Beaver Dam Cr	021403040270	Double Pipe Creek	Middle Potomac	Frederick	4-Mar-02	18-Jul-02	1	3138
DOUB-116-R-2002	Big Pipe Cr Ut 5	021403040287	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	10-Jul-02	1	546
DOUB-119-R-2002	Big Pipe Cr Ut 8	021403040283	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	10-Jul-02	1	394
DOUB-120-R-2002	Bear Br Ut	021403040281	Double Pipe Creek	Middle Potomac	Carroll	6-Mar-02	18-Jul-02	1	214
DOUB-122-R-2002	Bear Br	021403040282	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	9-Jul-02	1	2167
DOUB-212-R-2002	Turkey Foot Run	021403040275	Double Pipe Creek	Middle Potomac	Carroll	6-Mar-02	7-Aug-02	2	2909
DOUB-214-R-2002	Big Pipe Cr	021403040286	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	7-Aug-02	2	6011
DOUB-217-R-2002	Meadow Br	021403040277	Double Pipe Creek	Middle Potomac	Carroll	4-Mar-02	11-Jul-02	2	6926
DOUB-218-R-2002	Big Silver Run	021403040285	Double Pipe Creek	Middle Potomac	Carroll	5-Mar-02	9-Jul-02	2	3473
DOUB-221-R-2002	Bear Br	021403040281	Double Pipe Creek	Middle Potomac	Carroll	6-Mar-02	11-Jul-02	2	3357
DOUB-404-R-2002	Little Pipe Cr	021403040274	Double Pipe Creek	Middle Potomac	Carroll/Frederic	4-Mar-02	17-Jul-02	4	47878
DOUB-407-R-2002	Big Pipe Cr	021403040280	Double Pipe Creek	Middle Potomac	Carroll	4-Mar-02	12-Jun-02	4	65663

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
DOUB-101-R-2002	1.29	3.67	3.84	0	0
DOUB-103-R-2002	NR	2.78	1.47	0	0
DOUB-106-R-2002	NS	2.56		NS	NS
DOUB-109-R-2002	NS	3.00		NS	NS
DOUB-113-R-2002	2.14	3.89	55.95	0	0
DOUB-115-R-2002	2.14	2.78	27.93	0	0
DOUB-116-R-2002	2.43	4.56	62.37	0	0
DOUB-119-R-2002	1.57	4.56	11.37	0	0
DOUB-120-R-2002	NR	2.56	22.54	0	0
DOUB-122-R-2002	2.71	4.11	67.94	0	0
DOUB-212-R-2002	3.29	2.78	37.81	0	0
DOUB-214-R-2002	2.71	3.67	82.48	0	0
DOUB-217-R-2002	3.29	3.44	64.27	0	0
DOUB-218-R-2002	2.43	4.11	46.78	0	0
DOUB-221-R-2002	1.57	4.33	70.98	0	0
DOUB-404-R-2002	2.43	3.00	88.66	0	0
DOUB-407-R-2002	2.43	3.89	21.14	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
DOUB-101-R-2002	1.09	93.37	4.51	1.03	0.79
DOUB-103-R-2002	1.05	93.04	5.12	0.79	0.26
DOUB-106-R-2002	0.45	71.03	28.52	0.00	0.11
DOUB-109-R-2002	0.02	90.53	9.24	0.21	0.02
DOUB-113-R-2002	4.65	59.09	34.83	1.43	1.22
DOUB-115-R-2002	0.18	85.04	14.24	0.55	0.08
DOUB-116-R-2002	0.04	47.02	52.85	0.08	0.01
DOUB-119-R-2002	0.57	61.38	38.05	0.00	0.14
DOUB-120-R-2002	0.00	84.11	15.68	0.21	0.00
DOUB-122-R-2002	0.69	88.35	10.75	0.22	0.17
DOUB-212-R-2002	0.37	73.07	24.54	2.03	0.21
DOUB-214-R-2002	1.03	77.27	21.17	0.53	0.30
DOUB-217-R-2002	1.31	81.64	15.70	1.35	0.47
DOUB-218-R-2002	0.89	72.65	24.82	1.64	0.40
DOUB-221-R-2002	0.54	78.58	19.62	1.26	0.15
DOUB-404-R-2002	1.98	80.77	16.24	1.01	0.67
DOUB-407-R-2002	2.04	37.29	57.88	2.79	0.72

Conewago Creek/Double Pipe Creek
Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
DOUB-101-R-2002	8.08	483.7	2217.1	47.957	4.633	24.654	0.0093	0.0007	0.0099	0.0072	4.6603	2.7333	3.5	9.2
DOUB-103-R-2002	7.57	174.8	1023.7	6.491	2.161	9.006	0.0596	0.0154	0.0129	0.0890	2.2944	1.8587	6.9	5.9
DOUB-106-R-2002	7.50	168.5	740.5	14.495	2.495	8.229	0.0106	0.0029	0.0037	0.0085	2.4901	1.6560	NS	NS
DOUB-109-R-2002	7.72	868.5	4122.5	95.274	2.796	41.955	1.4254	0.8861	0.1700	7.9438	13.4778	21.9972	NS	NS
DOUB-113-R-2002	7.80	248.8	1076.0	25.686	3.567	7.828	0.0138	0.0007	0.0119	0.0082	3.5081	1.1600	7.8	1.3
DOUB-115-R-2002	7.83	423.0	2450.6	28.852	3.596	18.147	0.1257	0.0343	0.0403	0.1652	3.8455	3.9487	4.3	6.7
DOUB-116-R-2002	7.20	116.3	517.7	7.988	1.382	6.477	0.0072	0.0028	0.0018	0.0052	1.4069	1.0127	7.5	0.1
DOUB-119-R-2002	7.41	106.9	464.2	8.346	1.182	5.628	0.0155	0.0045	0.0021	0.0065	1.2472	1.0155	5.1	5.7
DOUB-120-R-2002	7.79	143.9	689.4	8.718	2.675	7.211	0.0106	0.0007	0.0047	0.0072	2.6020	1.0907	8.9	4.2
DOUB-122-R-2002	7.56	282.0	1499.6	18.492	3.632	11.218	0.0131	0.0007	0.0085	0.0105	4.0399	1.3847	7.5	7.5
DOUB-212-R-2002	8.50	559.3	2910.8	57.744	4.653	23.560	0.0546	0.0112	0.0144	0.0063	4.6195	1.2719	10.6	7.6
DOUB-214-R-2002	7.67	221.3	886.2	21.876	3.816	7.437	0.0292	0.0082	0.0108	0.0266	3.8251	1.5118	8	6.5
DOUB-217-R-2002	7.92	384.5	1679.6	41.715	4.236	14.810	0.0290	0.0043	0.0153	0.0178	4.2689	2.3621	9.1	7
DOUB-218-R-2002	7.63	279.7	1424.8	22.719	2.708	11.787	0.0117	0.0007	0.0064	0.0107	2.7754	1.6962	6.4	17
DOUB-221-R-2002	7.37	233.2	931.5	24.158	4.632	8.146	0.0940	0.0498	0.0206	0.0466	4.6866	1.2799	7.5	11.5
DOUB-404-R-2002	7.92	513.2	2536.3	48.263	3.911	23.687	0.4215	0.2707	0.0813	0.5742	4.7610	6.9781	6.2	22.1
DOUB-407-R-2002	8.21	254.3	1193.7	22.043	3.459	10.063	0.0252	0.0055	0.0223	0.0188	3.5265	2.3180	4.9	12.1

Physical Habitat Condition

Site	Riparian Buffer	Riparian Buffer	Adjacent Cover	Adjacent Cover	Instream Habitat	Epifaunal Substrate	Velocity/ Depth	Pool/ Glide/	Extent of Pools (m)	Riffle/ Run	Extent of Riffles (m)	Embedd-edness	Shading (%)	Trash Rating	Maximum Depth
DOUB-101-R-2002	0	0	PA	CP	6	5	6	7	65	7	10	90	40	14	38
DOUB-103-R-2002	4	3	CP	CP	2	2	2	2	3	7	72	100	95	17	8
DOUB-106-R-2002	0	0	PA	PA	NS	NS	NS	NS	NS	NS	NS	NS	NS	15	NS
DOUB-109-R-2002	0	0	PA	PA	NS	NS	NS	NS	NS	NS	NS	NS	NS	16	NS
DOUB-113-R-2002	50	50	FR	FR	10	13	7	8	43	11	32	25	95	16	30
DOUB-115-R-2002	50	50	TG	TG	11	13	8	8	47	11	28	25	83	17	29
DOUB-116-R-2002	50	50	LN	FR	15	16	12	11	43	11	32	20	90	18	50
DOUB-119-R-2002	35	10	DI	PA	13	12	3	4	34	7	41	35	96	14	18
DOUB-120-R-2002	0	0	LN	LN	9	11	8	4	14	11	63	25	10	16	17
DOUB-122-R-2002	50	40	TG	DI	12	11	13	12	33	14	42	40	68	18	54
DOUB-212-R-2002	50	50	TG	TG	13	12	11	11	33	15	42	75	15	16	49
DOUB-214-R-2002	50	15	OF	CP	16	14	14	13	50	16	29	45	80	18	54
DOUB-217-R-2002	15	40	DI	CP	13	12	14	11	35	15	40	40	25	14	38
DOUB-218-R-2002	50	50	FR	FR	11	11	9	11	57	9	18	35	95	16	49
DOUB-221-R-2002	50	50	FR	FR	15	14	13	14	47	12	28	35	95	17	56
DOUB-404-R-2002	2	20	PV	GR	15	13	13	13	70	14	11	17	68	16	56
DOUB-407-R-2002	50	50	TG	FR	8	8	5	9	75	10	6	45	60	17	24

Conewago Creek/Double Pipe Creek

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
DOUB-101-R-2002	Y	N	N	N	Moderate	Moderate	Mild
DOUB-103-R-2002	N	N	N	Y	Mild	Mild	None
DOUB-106-R-2002	Y	N	N	N	NS	NS	NS
DOUB-109-R-2002	Y	N	N	N	NS	NS	NS
DOUB-113-R-2002	N	N	N	N	Moderate	Moderate	Mild
DOUB-115-R-2002	N	N	N	N	Mild	Mild	Mild
DOUB-116-R-2002	N	N	N	N	Mild	Moderate	Moderate
DOUB-119-R-2002	Y	N	N	N	Moderate	Moderate	Severe
DOUB-120-R-2002	Y	N	N	N	Moderate	Mild	Mild
DOUB-122-R-2002	N	N	Y	N	Moderate	Moderate	Severe
DOUB-212-R-2002	N	N	N	N	Severe	Severe	None
DOUB-214-R-2002	N	N	N	N	Moderate	Moderate	Mild
DOUB-217-R-2002	Y	N	N	N	Moderate	Severe	Mild
DOUB-218-R-2002	N	N	N	N	Moderate	Moderate	Moderate
DOUB-221-R-2002	N	N	N	N	Moderate	Moderate	Moderate
DOUB-404-R-2002	Y	N	N	N	Severe	Severe	Mild
DOUB-407-R-2002	N	N	N	N	Mild	Mild	Moderate

Interpretation of Watershed Condition

- Highly agricultural watershed with high nitrate values at all sites
- Turbidity high at 3 sites
- No riparian buffer at several sites

Conewago Creek/Double Pipe Creek

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BLUNTNOSE MINNOW
CENTRAL STONEROLLER
CHANNEL CATFISH
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
CYPRINID HYBRID
EASTERN SILVERY MINNOW
FANTAIL DARTER
FATHEAD MINNOW
GREEN SUNFISH
GREENSIDE DARTER
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
MOSQUITOFISH
NONE
NORTHERN HOGSUCKER
POTOMAC SCULPIN
REDBREAST SUNFISH
RIVER CHUB
ROCK BASS
ROSYFACE SHINER
ROSYSIDE DACE
SATINFIN SHINER
SILVERJAW MINNOW
SMALLMOUTH BASS
SPOTFIN SHINER
SPOTTAIL SHINER
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ACERPENNA
AGABUS
ALLOPERLA
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
ATHERIX
BAETIDAE
BEROSUS
BRILLIA
CAECIDOTEA
CAPNIIDAE
CARDIOCLADIUS
CERATOPOGONIDAE
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMIDAE
CHIRONOMINAE
CHIRONOMINI
CHIRONOMUS
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
CURA
DIAMESA
DIAMESINAE
DICRANOTA
DINEUTUS
DIPLECTRONA
DIPLOCLADIUS
DIPTERA
DOLOPHILODES
DUBIRAPHIA
DUGESIA
ECTOPRIA
ELMIDAE
EMPIDIDAE
ENCHYTRAEIDAE
EPEORUS
EPHEMERELLA
EPHEMERELLIDAE
EUKIEFFERIELLA
FERRISSIA
GLOSSOSOMA
GORDIIDAE
HEMERODROMIA
HEPTAGENIIDAE
HETEROTRISSOCLADIUS
HEXATOMA
HYALELLA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
PARAMETRIOCNEMUS
TVETENIA
MEROPELOPIA
HYDROPSYCHIDAE
STENONEMA
PROSTOIA
TALLAPERLA
ISONYCHIA
TAENIOPTERYX
RHYACOPHILA
ISOPERLA
MICROPSECTRA
ISOTOMURUS
ORTHOCLADIUS
LEPTOPHLEBIA
TRISSOPELOPIA
SYMPOTTHASTIA
CHELIFERA
PROSIMULIUM
TUBIFICIDAE
LEPTOPHLEBIIDAE
EPHEMERA
EURYLOPHELLA
LEUCTRIDAE
LIMNOPHYES
OSTROCERCA
LYPE
HYDATOPHYLAX
OPTIOSERVUS
ORTHOCLADIINAE
MACRONYCHUS
TANYPODINAE
ZAVRELIMYIA
NATARSIA
BEZZIA
PROBEZZIA
TANYTARSINI
TANYTARSUS
MICROCYLLOEPUS
THIENEMANNIELLA
SIMULIUM
AMPHIPODA
PARACAPNIA
PHILOPOTAMIDAE
NEOPHYLAX
STENELMIS
MICROTENDIPES
PHAENOPSECTRA
RHEOTANYTARSUS
STEMPELLINELLA
PARAKIEFFERIELLA
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
OEMOPTERYX
OULIMNIUS
PAGASTIA
PARAPHAENOCLADIUS
PARATANYTARSUS
PERLESTA

Conewago Creek/Double Pipe Creek

PERLIDAE
PERLODIDAE
PHYSELLA
PLANORBELLA
POLYPEDILUM
POTTHASTIA
PRODIAMESA
PSEPHENUS
PSEUDOLIMNOPHILA
PSEUDORTHOCLADIUS
PSEUDOSUCCINEA
PSYCHOMYIIDAE
PYCNOPSYCHE
RHEOCRICOTOPUS
SCIRTIDAE
SERRATELLA
SIALIS
SIMULIIDAE
SPERCHOPSIS
SPHAERIIDAE
SPIROSPERMA
STAGNICOLA
STENOCHIRONOMUS
STICTOCHIRONOMUS
STROPHOPTERYX
STYGONECTES
TABANUS
THIENEMANNIMYIA GROUP
TIPULA

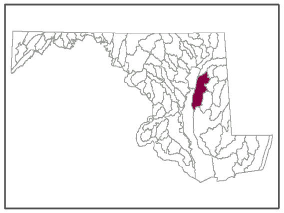
Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
EASTERN GARTER SNAKE
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
QUEEN SNAKE
RED SALAMANDER

Conewago Creek/Double Pipe Creek

Stream Waders Data

Site	8-Digit Watershed	Stream Name	Benthic IBI
248-1	Double Pipe Creek	Double Pipe Creek	3.00
268-1	Double Pipe Creek	Sam’s Creek	2.43
268-2	Double Pipe Creek	Sam’s Creek	3.00
268-3	Double Pipe Creek	Sam’s Creek	3.00
268-4	Double Pipe Creek	Sam’s Creek	1.29
268-5	Double Pipe Creek	Sam’s Creek	1.86
271-1	Double Pipe Creek	Dickinson Run	2.43
271-2	Double Pipe Creek	Dickinson Run	1.29
271-3	Double Pipe Creek	Dickinson Run	2.71
271-4	Double Pipe Creek	Dickinson Run UT	
271-5	Double Pipe Creek	Dickinson Run	3.29
272-1	Double Pipe Creek	Roop Branch	2.14
272-2	Double Pipe Creek	Roop Branch	1.86
272-3	Double Pipe Creek	Little Pipe Creek	1.29
272-4	Double Pipe Creek	Little Pipe Creek	1.57
272-5	Double Pipe Creek	Little Pipe Creek	1.29
273-1	Double Pipe Creek	Little Pipe Creek UT	
273-2	Double Pipe Creek	Wolf Pit Branch	1.00
273-3	Double Pipe Creek	Wolf Pit Creek	1.57
273-4	Double Pipe Creek	Little Pipe Creek	1.86
274-1	Double Pipe Creek	Little Pipe Creek	3.00
274-5	Double Pipe Creek	Haines Branch	1.00
275-1	Double Pipe Creek	Turkeyfoot Creek UT	1.57
276-1	Double Pipe Creek	Little Pipe Creek	1.57
277-1	Double Pipe Creek	Meadow Branch	3.00
277-2	Double Pipe Creek	Meadow Branch	2.14
277-3	Double Pipe Creek	Meadow Branch UT	1.00
277-4	Double Pipe Creek	Meadow Branch	1.00
277-5	Double Pipe Creek	Meadow Branch	2.14
279-1	Double Pipe Creek	Big Pipe Creek UT	1.57
279-2	Double Pipe Creek	Big Pipe Creek	3.29
279-3	Double Pipe Creek	Big Pipe Creek UT	1.29
279-4	Double Pipe Creek	Big Pipe Creek	1.57
279-5	Double Pipe Creek	Big Pipe Creek	3.29
281-1	Double Pipe Creek	Bear Branch	2.43
283-1	Double Pipe Creek	Big Pipe Creek	3.86
285-1	Double Pipe Creek	Big Silver Run UT	4.43
286-1	Double Pipe Creek	Big Pipe Creek	3.29
287-1	Double Pipe Creek	Big Pipe Creek UT	3.00
288-1	Double Pipe Creek	Deep Run	3.29



Eastern Bay/Kent Narrows/
Lower Chester River/Langford Creek
Kent Island Bay wate
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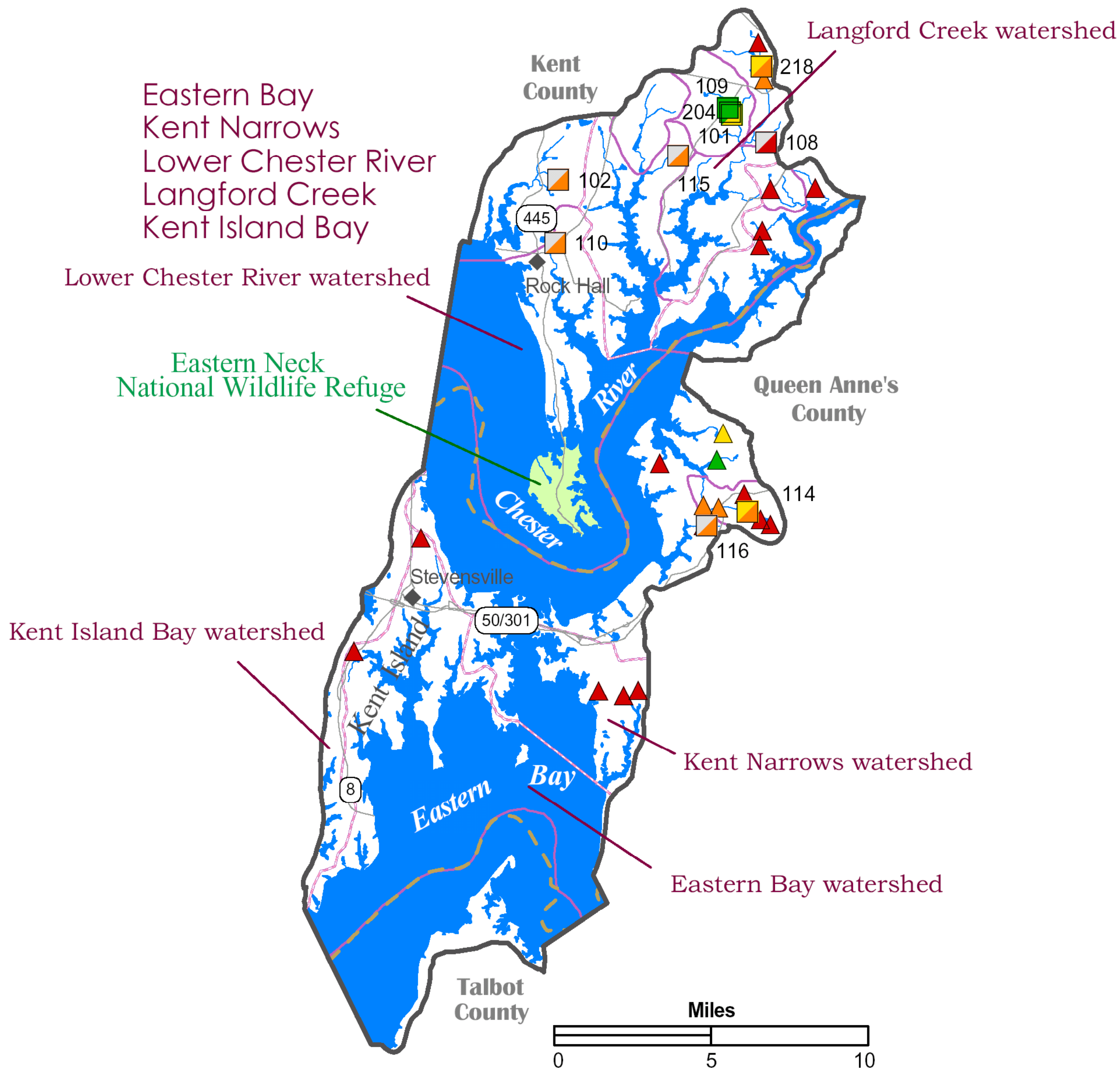
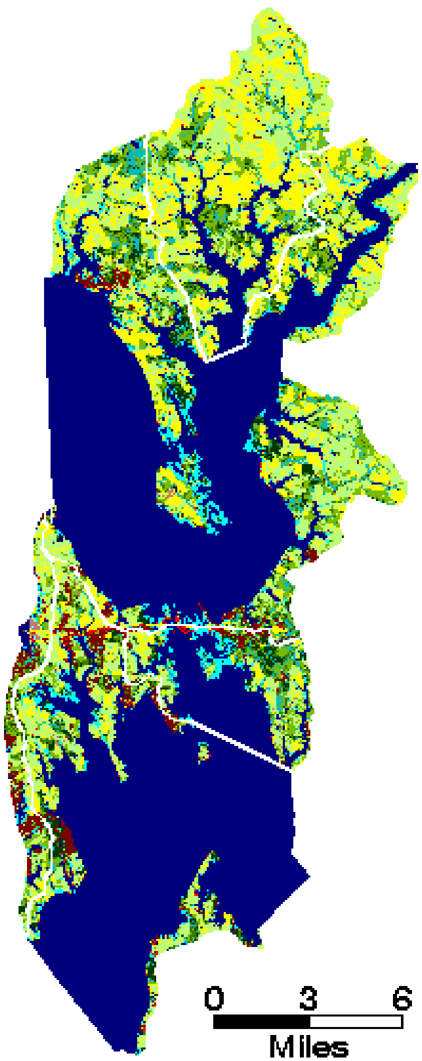
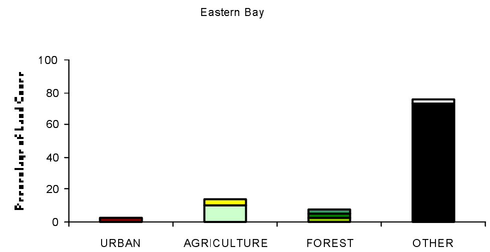
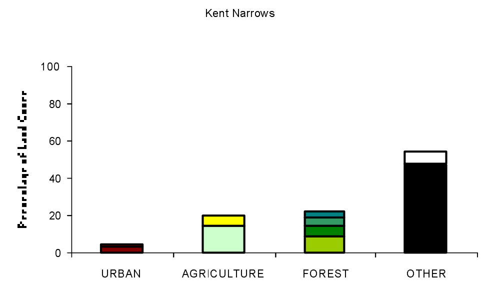
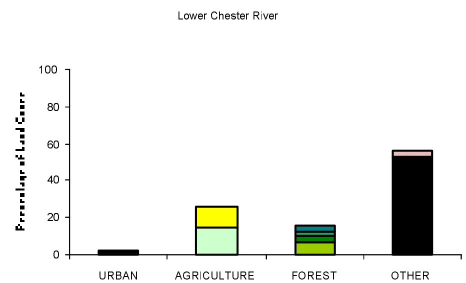


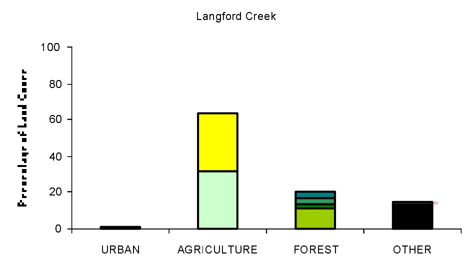
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay

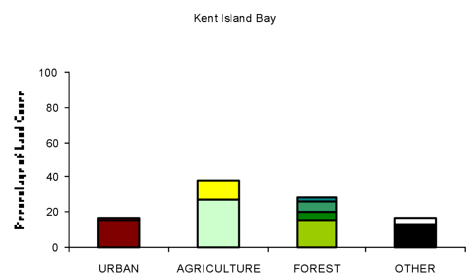












Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled	Date Sampled	Order	Catchment Area (acres)
LANG-101-R-2002	East Fork Langford Cr Ut 2	021305060408	Langford Creek	Chester River	Kent	14-Mar-02	11-Jun-02	1	1829
LANG-108-R-2002	East Fork Langford Cr Ut 1	021305060409	Langford Creek	Chester River	Kent	27-Mar-02	5-Jun-02	1	300
LANG-109-R-2002	East Fork Langford Cr Ut 2	021305060408	Langford Creek	Chester River	Kent	14-Mar-02	11-Jun-02	1	1391
LANG-115-R-2002	West Fork Langford Cr Ut 1	021305060405	Langford Creek	Chester River	Kent	27-Mar-02	18-Jun-02	1	193
LANG-204-R-2002	East Fork Langford Cr	021305060408	Langford Creek	Chester River	Kent	14-Mar-02	5-Jun-02	2	3477
LANG-218-R-2002	East Fork Langford Cr	021305060409	Langford Creek	Chester River	Kent	2-Apr-02	19-Jun-02	2	1542
LOCR-102-R-2002	Swan Cr Ut	021305050388	Lower Chester River	Chester River	Kent	27-Mar-02	6-Jun-02	1	482
LOCR-110-R-2002	Grays Inn Cr Ut	021305050389	Lower Chester River	Chester River	Kent	27-Mar-02	18-Jun-02	1	714
LOCR-114-R-2002	Reed Cr	021305050391	Lower Chester River	Chester River	Queen Annes	28-Mar-02	8-Aug-02	1	844
LOCR-116-R-2002	Queenstown Cr Ut	021305050390	Lower Chester River	Chester River	Queen Annes	1-Apr-02	24-Jun-02	1	142

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
LANG-101-R-2002	4.50	3.57	88.54	0	0
LANG-108-R-2002	NS	1.86	NS	NS	NS
LANG-109-R-2002	4.50	4.43	88.54	0	0
LANG-115-R-2002	NR	2.71	20.64	0	0
LANG-204-R-2002	4.25	3.29	53.49	0	0
LANG-218-R-2002	3.00	2.71	43.89	0	0
LOCR-102-R-2002	NR	2.43	18.89	1	0
LOCR-110-R-2002	NR	2.43	45.52	1	0
LOCR-114-R-2002	3.00	2.14	44.43	0	0
LOCR-116-R-2002	NR	2.43	54.04	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious
LANG-101-R-2002	1.17	84.58	13.23	1.02	0.41
LANG-108-R-2002	0.89	72.69	24.11	2.31	0.60
LANG-109-R-2002	1.41	86.10	11.23	1.26	0.49
LANG-115-R-2002	0.34	67.16	31.80	0.69	0.09
LANG-204-R-2002	0.47	84.36	13.64	1.53	0.23
LANG-218-R-2002	0.68	88.30	9.61	1.41	0.29
LOCR-102-R-	0.56	71.65	22.55	5.24	0.28
LOCR-110-R-	2.68	40.20	56.93	0.19	0.76
LOCR-114-R-	0.37	65.26	30.50	3.87	0.12
LOCR-116-R-	0.93	80.31	18.76	0.00	0.23

Interpretation of Watershed Condition

- Highly agricultural watershed with high nitrogen and phosphorus values at many sites
- Turbidity high at some sites
- Dissolved oxygen low at some sites
- Absence of riffles indicative of Eastern Shore streams

Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LANG-101-R-2002	6.89	151.4	394.7	16.912	4.739	4.448	0.0106	0.0035	0.0258	0.0581	4.8019	1.6045	7.8	4
LANG-108-R-2002	6.10	88.4	217.1	8.881	0.085	10.217	0.2212	0.0673	0.0053	0.0197	0.9016	14.0210	NS	NS
LANG-109-R-2002	6.81	154.2	367.1	17.578	5.143	4.442	0.0876	0.0052	0.0311	0.0720	5.2307	1.8461	7.4	11.7
LANG-115-R-2002	6.29	132.6	176.6	18.773	4.539	2.763	0.0239	0.0007	0.0062	0.0225	4.6691	4.2906	6.1	7.8
LANG-204-R-2002	7.28	136.2	665.2	11.270	1.834	5.574	0.0635	0.0049	0.0258	0.0458	2.0693	3.4714	5	19.3
LANG-218-R-2002	7.11	160.0	624.2	13.471	2.909	8.732	0.0839	0.0049	0.0477	0.0549	3.2492	3.9821	5.7	5.3
LOCR-102-R-2002	6.79	277.2	1118.0	27.087	0.192	23.804	0.3643	0.0128	0.0137	0.0600	2.5427	22.6444	2.5	40.2
LOCR-110-R-2002	5.80	167.7	115.9	20.580	0.136	30.732	0.1438	0.0359	0.0063	0.0203	0.7876	22.0127	2.1	24.9
LOCR-114-R-2002	7.31	293.1	1676.0	25.954	0.324	11.912	0.1114	0.0148	0.0331	2.7790	3.7634	7.9584	3	7.2
LOCR-116-R-2002	7.08	259.4	706.8	25.843	0.513	39.151	0.1335	0.0294	0.0038	0.0375	0.7312	4.1513	3.8	13

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
LANG-101-R-2002	50	50	FR	FR	16	17	15	16	61	16	15	100	75	15	101
LANG-108-R-2002	50	50	OF	LN	NS	NS	NS	NS	NS	NS	NS	NS	NS	13	NS
LANG-109-R-2002	50	50	FR	TG	14	16	13	14	51	15	24	35	70	18	81
LANG-115-R-2002	50	50	LN	FR	10	9	5	8	64	11	11	100	97	12	48
LANG-204-R-2002	45	50	CP	FR	13	14	9	11	54	16	21	100	55	19	48
LANG-218-R-2002	45	50	CP	FR	16	15	5	10	75	0	0	100	18	19	33
LOGU-103-R-2002	50	30	FR	PV	16	17	15	15	33	7	42	45	79	9	125
LOGU-106-R-2002	50	50	FR	FR	18	19	14	16	35	16	45	15	93	19	70
LOGU-108-R-2002	35	3	HO	HO	9	8	11	11	27	6	50	55	88	8	54
LOGU-109-R-2002	50	50	FR	FR	13	16	8	7	27	14	48	20	98	20	34
LOGU-202-R-2002	50	50	FR	FR	16	16	11	11	47	15	28	51	89	14	51
LOGU-211-R-2002	20	50	DI	DI	17	15	7	17	75	0	0	25	70	17	105
LOGU-305-R-2002	10	25	HO	PV	14	6	9	17	75	0	0	90	45	17	150

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LANG-101-R-2002	N	N	N	N	Mild	Mild	None
LANG-108-R-2002	N	N	N	N	NS	NS	NS
LANG-109-R-2002	Y	N	N	N	Mild	Mild	None
LANG-115-R-2002	N	N	N	N	Mild	Mild	Moderate
LANG-204-R-2002	N	N	N	N	Mild	Mild	Mild
LANG-218-R-2002	N	N	N	N	None	None	None
LOCR-102-R-2002	N	N	N	N	Moderate	Moderate	Moderate
LOCR-110-R-2002	N	N	N	N	Mild	Mild	None
LOCR-114-R-2002	N	N	N	N	Moderate	Moderate	Severe
LOCR-116-R-2002	N	N	N	N	Severe	Severe	Severe

Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay

Fish Species Present
AMERICAN EEL
BANDED KILLIFISH
BLACK CRAPPIE
BLUEGILL
BROWN BULLHEAD
COMMON CARP
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
GOLDFISH
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MOSQUITOFISH
PUMPKINSEED
REDFIN PICKEREL
SATINFIN SHINER
SPOTTAIL SHINER
TESSELLATED DARTER

Exotic Plants Present
JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE

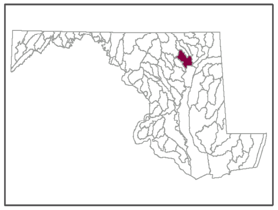
Benthic Taxa Present
ABLABESMYIA
ACERPENNA
AEDES
ANCYLIDAE
ANCYRONYX
APSECTROTANYPUS
ARGIA
BELOSTOMA
BEZZIA
CAECIDOTEA
CAENIS
CALOPTERYX
CAMBARIDAE
CAMBARUS
CAMPELOMA
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHAULIODES
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINI
CLINOTANYPUS
COENAGRIONIDAE
CONCHAPELOPIA
CORDULEGASTER
CORYNONEURA
CRANGONYCTIDAE
CRANGONYX
CRICOTOPUS
CRYPTOCHIRONOMUS
CULICOIDES
CURA
DICROTENDIPES
DINEUTUS
DIPLOCLADIUS
DUBIRAPHIA
DUGESIA
DYTISCIDAE
ENCHYTRAEIDAE
ERPOBDELLIDAE
GAMMARUS
GASTROPODA
GERRIS
GORDIIDAE
GYRAULUS
HETEROTRISSOCLADIUS
HYALELLA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
ISCHNURA
ISOTOMIDAE
KIEFFERULUS
LABRUNDINIA
LEPIDOPTERA
LEPTOPHLEBIIDAE
LIBELLULIDAE
LIMNEPHILIDAE
LIMNODRILUS
LIMNOPHYES
LUMBRICULIDAE
LYPE
MACRONYCHUS
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
MUSCULIUM
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
NEOPHYLAX
OECETIS
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
PARACHIRONOMUS
PARAKIEFFERIELLA
PARALAUTERBORNIELLA
PARAMERINA
PARAMETRIOCNEMUS
PARATANYTARSUS
PARATENDIPES
PELTODYTES
PHAENOPSECTRA
PHYLOCENTROPUS
PHYSELLA
PISIDIUM
POLYCENTROPODIDAE
POLYCENTROPUS
POLYPEDILUM
POTTHASTIA
PROBEZZIA
PROCLADIUS
PROSIMULIUM
PROSTOMA
PSEUDOLIMNOPHILA
PSEUDOSMITTIA
PSEUDOSUCCINEA
PTILOSTOMIS
PYRALIDAE
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIALIS
SIMULIUM
SPHAERIIDAE
STEMPELLINELLA
STENELMIS
STENOCHIRONOMUS
STENONEMA
SYMPOSIOCLADIUS
TABANIDAE
TANYPODINAE
TANYPUS
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
TIPULIDAE
TRIAENODES
TROPISTERNUS
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

Herpetofauna Present
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
EASTERN PAINTED TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
SOUTHERN LEOPARD FROG

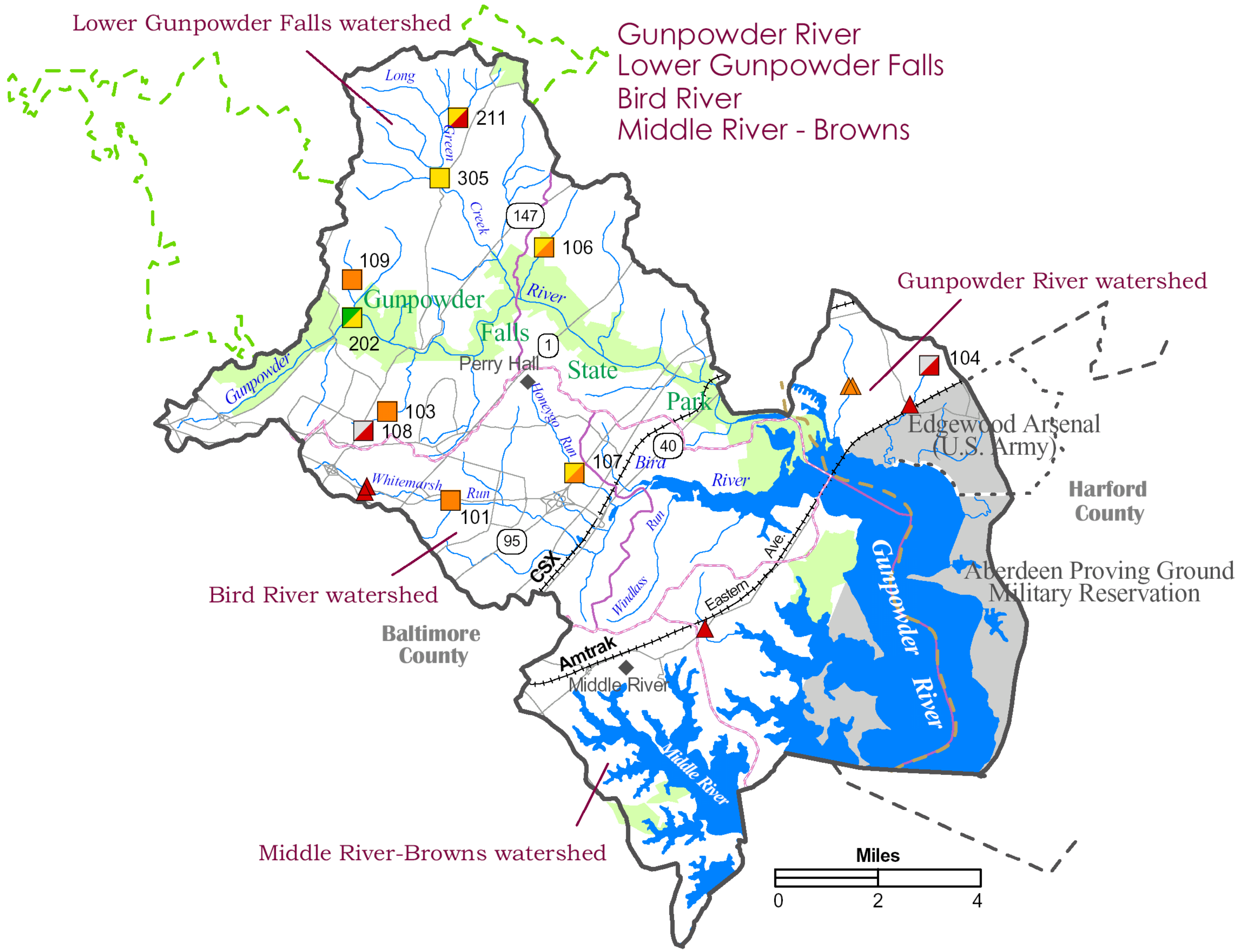
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay

Stream Waders Data

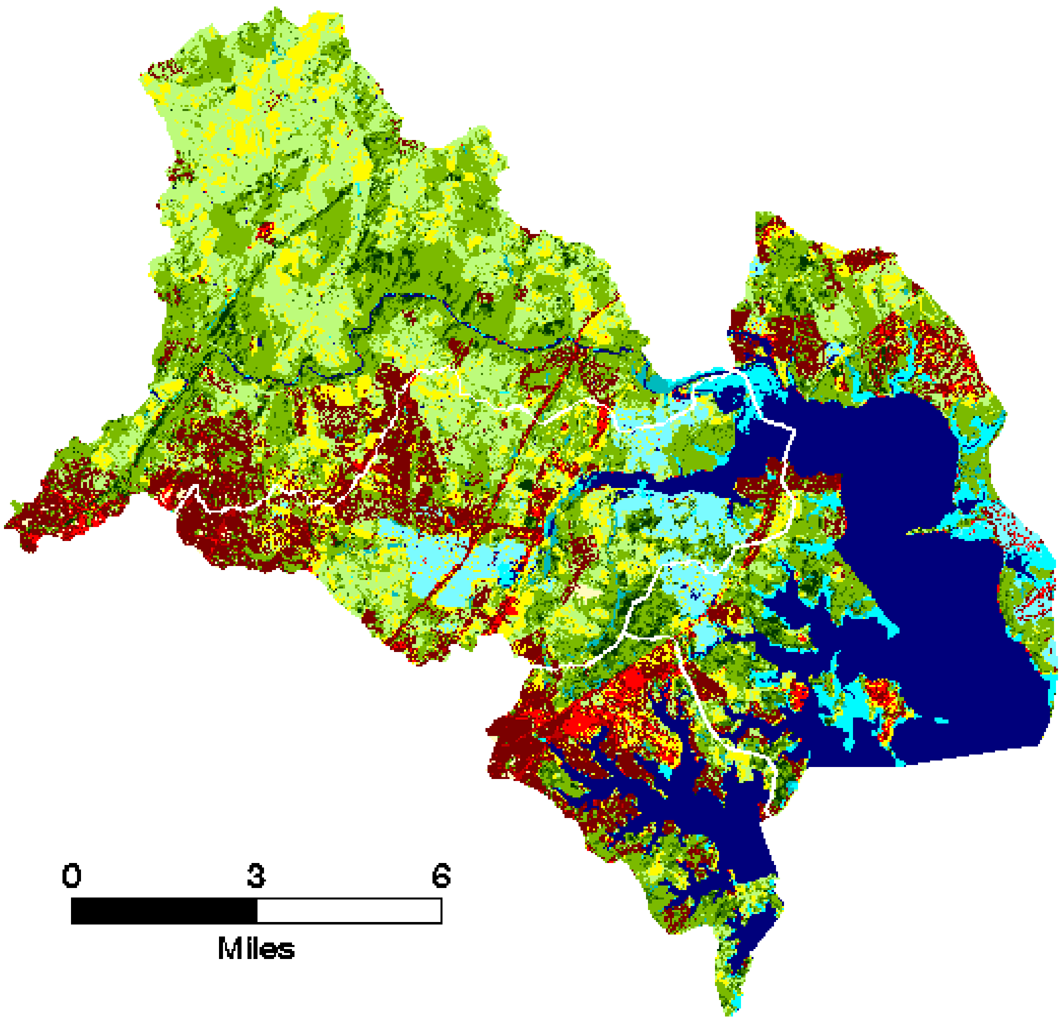
Site	8-Digit Watershed	Stream Name	Benthic IBI
429-1	Eastern Bay	Cox Creek	1.29
429-2	Eastern Bay	Warehouse Creek	1.57
431-1	Kent Narrows	Greenwood Creek West Fork	1.29
431-2	Kent Narrows	Greenwood Creek	1.29
431-3	Kent Narrows	Hoghole Creek	1.00
409-1	Langford Creek	Langford Creek East Fork	1.86
409-2	Langford Creek	Langford Creek East Fork	2.14
390-1	Lower Chester River	Head of Queenstown Creek UT	1.57
390-2	Lower Chester River	Northeastern branch of Reed Cr	4.43
390-3	Lower Chester River	Head of Grove Creek UT off Spi	3.57
390-4	Lower Chester River	Head of Spring Cove	1.57
391-1	Lower Chester River	Reed Creek	2.43
391-2	Lower Chester River	Reed Creek	2.14
391-3	Lower Chester River	Reed Creek UT	1.29
391-4	Lower Chester River	Reed Creek headwaters	1.00
391-5	Lower Chester River	Reed Creek headwaters	1.29
393-1	Lower Chester River	Dam Creek	1.57
393-2	Lower Chester River	Jarrett Creek	1.57
393-3	Lower Chester River	Browns Creek	1.57
394-1	Lower Chester River	Broad Creek headwaters	1.29

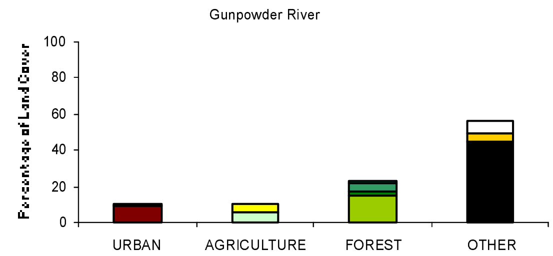


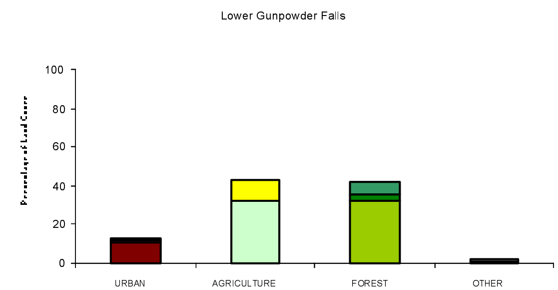
Gunpowder River/
Lower Gunpowder Falls/
Bird River/
Middle Rive
MBSS 2002

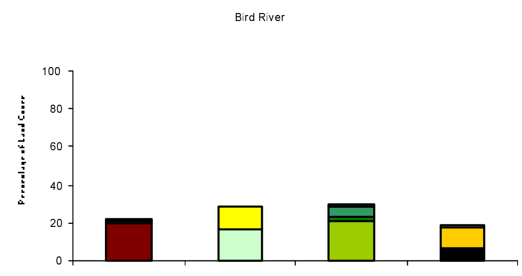


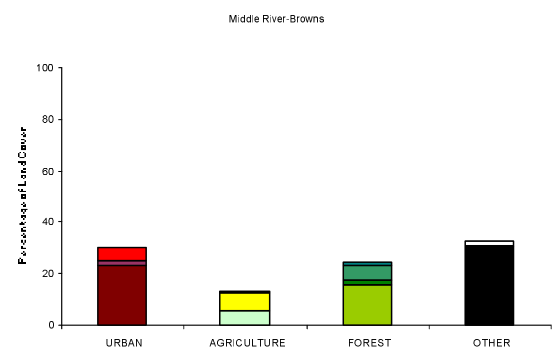
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns











Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
BIRD-101-R-2002	White Marsh Run	021308030295	Bird River	Gunpowder River	Baltimore	25-Mar-02	11-Jun-02	1	1942
BIRD-107-R-2002	Honey Go Run	021308030295	Bird River	Gunpowder River	Baltimore	26-Mar-02	10-Jun-02	1	1306
GUNP-104-R-2002	Reardon Inlet Ut	021308010293	Gunpowder River	Gunpowder River	Harford	26-Mar-02	17-Jun-02	1	80
LOGU-103-R-2002	Jennifer Br	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	7-Mar-02	12-Jun-02	1	661
LOGU-106-R-2002	Sweathouse Br	021308020296	Lower Gunpowder Falls	Gunpowder River	Baltimore	7-Mar-02	12-Jun-02	1	745
LOGU-108-R-2002	Jennifer Br	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	6-Mar-02	12-Jun-02	1	134
LOGU-109-R-2002	Cowen Run Ut 1	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	26-Mar-02	11-Jun-02	1	447
LOGU-202-R-2002	Cowen Run	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	26-Mar-02	11-Jun-02	2	1866
LOGU-211-R-2002	Long Green Cr	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	7-Mar-02	13-Jun-02	2	1113
LOGU-305-R-2002	Long Green Cr	021308020297	Lower Gunpowder Falls	Gunpowder River	Baltimore	7-Mar-02	17-Jun-02	3	5147

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
BIRD-101-R-2002	2.33	2.33	73.44	0	0
BIRD-107-R-2002	3.22	2.11	42.23	0	0
GUNP-104-R-2002	NS	1.86	NS	NS	NS
LOGU-103-R-2002	2.56	2.56	54.94	0	0
LOGU-106-R-2002	3.22	2.33	96.48	0	0
LOGU-108-R-2002	NR	1.89	10.19	0	0
LOGU-109-R-2002	2.33	2.56	46.27	0	0
LOGU-202-R-2002	4.33	3.67	61.12	0	0
LOGU-211-R-2002	3.22	1.89	15.65	0	0
LOGU-305-R-2002	3.22	3.22	6.88	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
BIRD-101-R-2002	58.71	18.87	21.65	0.78	17.85
BIRD-107-R-2002	9.20	60.16	30.23	0.41	2.72
GUNP-104-R-2002	47.53	44.23	8.24	0.00	17.65
LOGU-103-R-2002	64.21	8.78	27.01	0.00	18.28
LOGU-106-R-2002	2.53	61.24	35.93	0.30	0.63
LOGU-108-R-2002	78.81	4.80	16.39	0.00	23.10
LOGU-109-R-2002	3.48	38.82	57.55	0.15	0.87
LOGU-202-R-2002	2.95	36.01	60.46	0.58	0.90
LOGU-211-R-2002	0.32	75.01	24.07	0.60	0.10
LOGU-305-R-2002	1.75	75.08	22.85	0.31	0.46

Interpretatin of Watershed Condition

- Several sites with high urban land use and impervious surface
- Two sites with high agricultural land use
- Chloride elevated at many sites
- Nitrogen and phosphorus elevated at many sites
- Problems with channelization and erosion throughout watershed

Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
BIRD-101-R-2002	7.83	731.2	1729.6	148.917	0.337	31.359	0.0087	0.0007	0.0027	0.0176	0.4894	2.5237	6.4	3.9
BIRD-107-R-2002	7.21	298.0	806.4	43.833	0.969	22.655	0.0179	0.0035	0.0038	0.0298	1.1517	3.1074	7.5	4.3
GUNP-104-R-2002	6.38	147.3	275.8	6.940	0.226	34.556	0.2625	0.0139	0.0031	0.0704	0.6412	4.8621	NS	NS
LOGU-103-R-2002	7.72	523.1	1784.5	82.158	1.939	21.187	0.0099	0.0024	0.0028	0.0043	2.0256	2.4801	5.8	0.2
LOGU-106-R-2002	7.61	299.0	761.4	43.318	2.465	13.752	0.0130	0.0056	0.0037	0.0130	2.4758	1.8427	7.8	1.1
LOGU-108-R-2002	7.61	639.5	2260.3	101.469	1.537	24.379	0.0134	0.0020	0.0050	0.1031	1.7258	3.0952	6.9	0.2
LOGU-109-R-2002	7.57	212.0	851.5	29.845	1.467	7.486	0.0130	0.0051	0.0008	0.0101	1.5335	1.1678	7.7	0.1
LOGU-202-R-2002	8.07	391.8	2508.1	32.410	1.882	12.599	0.0500	0.0201	0.0050	0.0223	1.9992	1.8112	8.7	1.6
LOGU-211-R-2002	7.81	354.1	2191.8	24.208	4.389	8.062	0.0252	0.0069	0.0042	0.0079	4.4256	1.2137	6.1	1.2
LOGU-305-R-2002	7.97	356.2	2019.4	24.013	4.778	9.639	0.0496	0.0171	0.0194	0.0353	4.8409	1.4914	7.7	3.7

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
BIRD-101-R-2002	48	50	HO	FR	12	13	9	9	57	14	29	35	80	8	32
BIRD-107-R-2002	50	50	FR	FR	13	13	12	14	41	8	34	40	90	10	54
GUNP-104-R-2002	50	50	LN	LN	NS	NS	NS	NS	NS	NS	NS	NS	NS	14	NS
LOGU-103-R-2002	50	30	FR	PV	16	17	15	15	33	7	42	45	79	9	125
LOGU-106-R-2002	50	50	FR	FR	18	19	14	16	35	16	45	15	93	19	70
LOGU-108-R-2002	35	3	HO	HO	9	8	11	11	27	6	50	55	88	8	54
LOGU-109-R-2002	50	50	FR	FR	13	16	8	7	27	14	48	20	98	20	34
LOGU-202-R-2002	50	50	FR	FR	16	16	11	11	47	15	28	51	89	14	51
LOGU-211-R-2002	20	50	DI	DI	17	15	7	17	75	0	0	25	70	17	105
LOGU-305-R-2002	10	25	HO	PV	14	6	9	17	75	0	0	90	45	17	150

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
BIRD-101-R-2002	N	N	N	Y	Moderate	Moderate	Severe
BIRD-107-R-2002	Y	N	N	N	Severe	Severe	Severe
GUNP-104-R-2002	Y	N	N	Y	NS	NS	NS
LOGU-103-R-2002	N	N	N	N	Moderate	Mild	Severe
LOGU-106-R-2002	N	N	N	N	Mild	Mild	Mild
LOGU-108-R-2002	Y	N	N	Y	Moderate	Mild	Severe
LOGU-109-R-2002	N	N	N	N	Moderate	Mild	Mild
LOGU-202-R-2002	N	N	N	N	Moderate	Severe	Severe
LOGU-211-R-2002	Y	N	N	Y	None	None	None
LOGU-305-R-2002	Y	N	N	Y	Moderate	Mild	Mild

Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns

Fish Species Present

AMERICAN EEL
BANDED KILLIFISH
BLACKNOSE DACE
BLUEGILL
BROWN TROUT
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
GOLDFISH
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
LONGNOSE DACE
POTOMAC SCULPIN
REDBREAST SUNFISH
ROSYSIDE DACE
SATINFIN SHINER
SEA LAMPREY
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
PHRAGMITES
THISTLE

Benthic Taxa Present

AMELETIDAE
AMELETUS
AMPHINEMURA
ANTOCHA
ARGIA
BOYERIA
BRILLIA
CAECIDOTEA
CALOPTERYX
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIRONOMIDAE
CLADOTANYTARSUS
CLINOCERA
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
DIAMESA
DIAMESINAE
DICROTENDIPES
DIPLECTRONA
DIPTERA
DUBIRAPHIA
DUGESIA
DYTISCIDAE
ELMIDAE
ENCHYTRAEIDAE
EPEORUS
EPHEMERELLA
EPHEMERELLIDAE
EUKIEFFERIELLA
EURYLOPHELLA
GLOSSOSOMATIDAE
GOMPHIDAE
GORDIIDAE
HEMERODROMIA
HIRUDINEA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
HYDROPSYCHIDAE
IRONOQUIA
ISONYCHIA
ISOTOMURUS
LEPIDOPTERA
LEUCTRIDAE
LIMNOPHYES
LUMBRICULIDAE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NEOPHYLAX
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARAKIEFFERIELLA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PERLESTA
PERLIDAE
PHAENOPSECTRA
PISIDIUM
POLYPEDILUM
PROSIMULIUM
PROSTOIA
PROSTOMA
RHEOTANYTARSUS
RHYACOPHILA
SIMULIUM
SPHAERIIDAE
STENELMIS
STENONEMA
SUBLETTEA
SYMPOTTHASTIA
SYNURELLA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

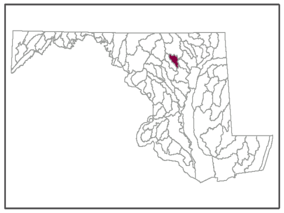
Herpetofauna Present

BULLFROG
EASTERN BOX TURTLE
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
PSEUDOTRITON SP.

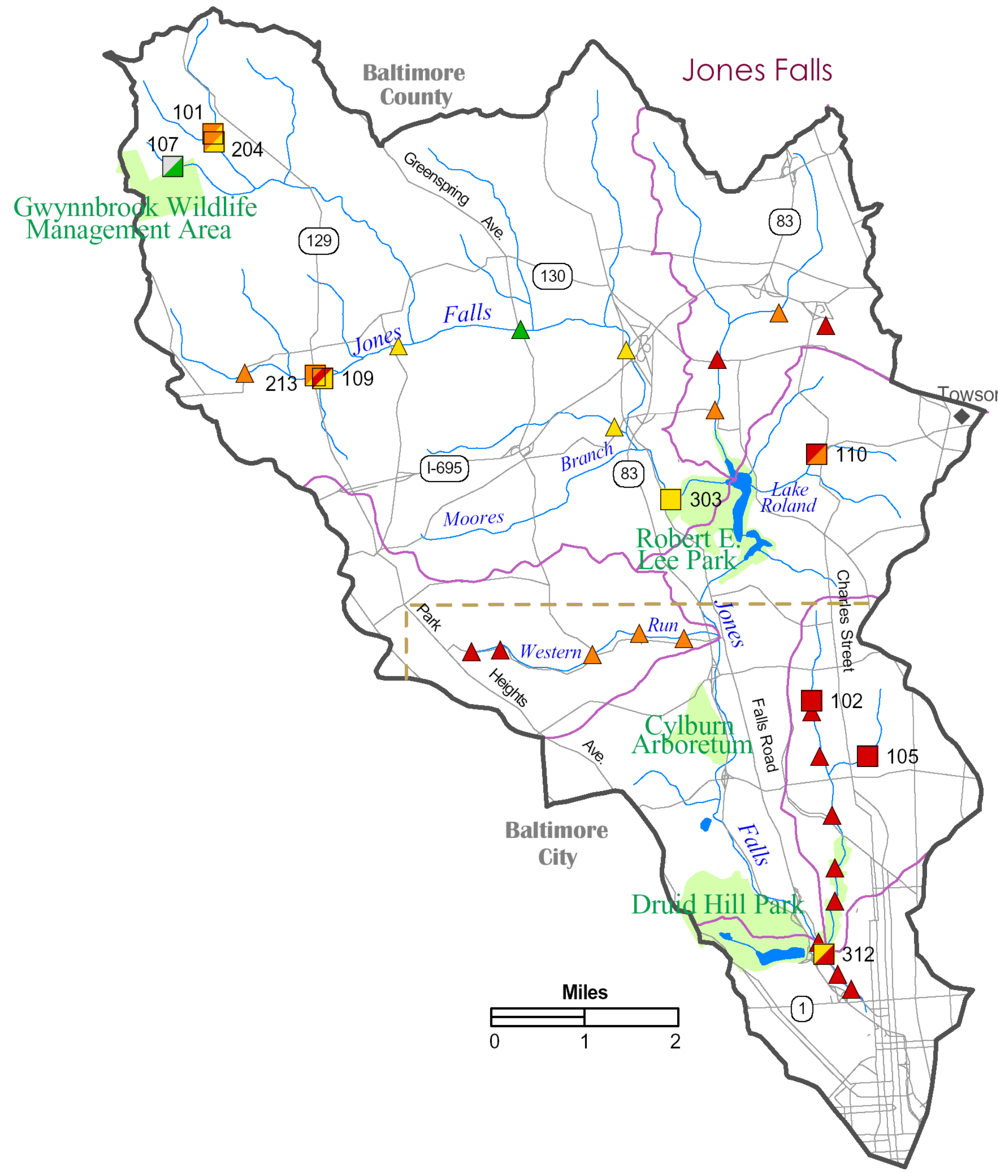
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns

Stream Waders Data

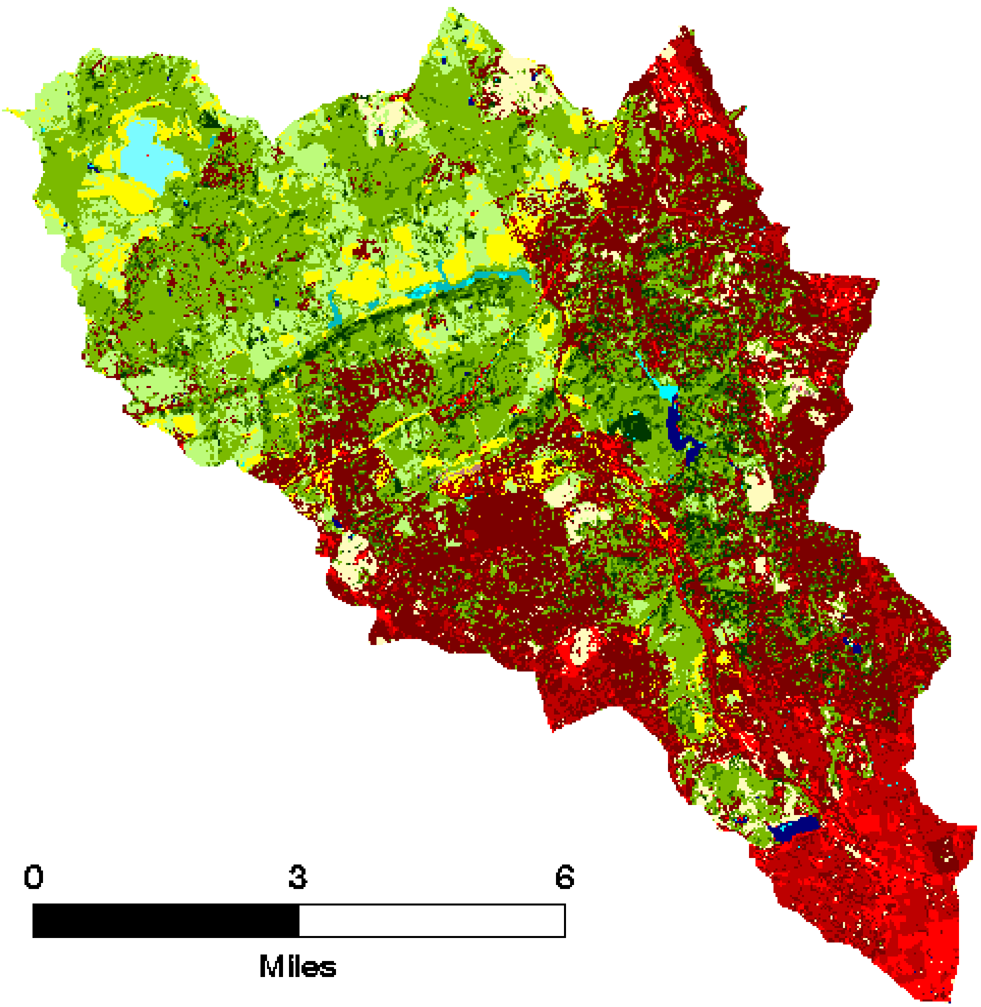
Site	8-Digit Watershed	Stream Name	Benthic IBI
295-91	Bird River	White Marsh Run	1.29
292-1	Gunpowder River	Saltpeter Creek UT	1.29
293-1	Gunpowder River	Foster Branch (east branch) UT	2.43
293-2	Gunpowder River	Foster Branch	2.43
293-3	Gunpowder River	Reardon Inlet UT	1.00



Jones Falls watershed
MBSS 2002



Jones Falls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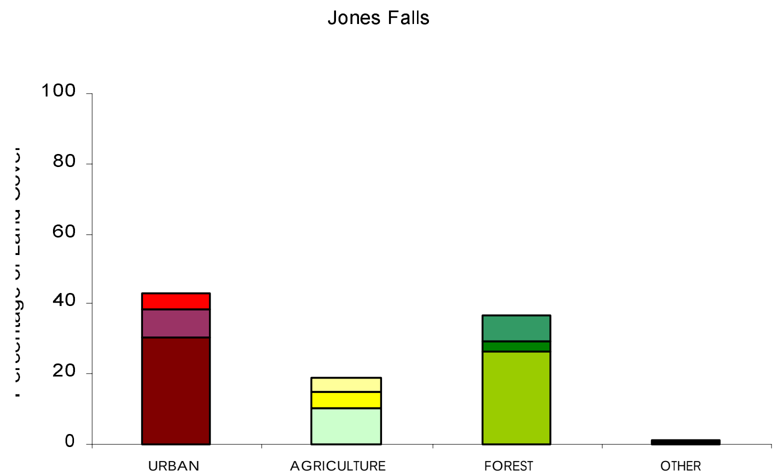
Jones Falls
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URBAN
AGRICULTURE
FOREST
OTHER

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
JONE-101-R-2002	North Br Ut 1_Ut1	021309041036	Jones Falls	Patapsco River	Baltimore	1-Apr-02	7-Aug-02	1	521
JONE-102-R-2002	Stony Run	021309041033	Jones Falls	Patapsco River	Baltimore City	26-Mar-02	4-Jun-02	1	416
JONE-105-R-2002	Stony Run Ut	021309041033	Jones Falls	Patapsco River	Baltimore City	3-Apr-02	4-Jun-02	1	488
JONE-107-R-2002	North Br	021309041036	Jones Falls	Patapsco River	Baltimore	1-Apr-02	7-Aug-02	1	153
JONE-109-R-2002	Jones Falls Ut 1	021309041036	Jones Falls	Patapsco River	Baltimore	1-Apr-02	19-Jun-02	1	756
JONE-110-R-2002	Towson Run	021309041034	Jones Falls	Patapsco River	Baltimore	4-Mar-02	18-Jun-02	1	1010
JONE-204-R-2002	North Br Ut 1	021309041036	Jones Falls	Patapsco River	Baltimore	1-Apr-02	7-Aug-02	2	820
JONE-213-R-2002	Jones Falls	021309041036	Jones Falls	Patapsco River	Baltimore	1-Apr-02	19-Jun-02	2	1731
JONE-303-R-2002	Jones Falls	021309041036	Jones Falls	Patapsco River	Baltimore	26-Mar-02	11-Jul-02	3	16694
JONE-312-R-2002	Jones Falls	021309041032	Jones Falls	Patapsco River	Baltimore City	4-Mar-02	25-Jul-02	3	89312

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
JONE-101-R-2002	2.78	3.89	69.70	0	0
JONE-102-R-2002	1.00	1.44	0.45	0	0
JONE-105-R-2002	1.00	1.44	0.51	0	0
JONE-107-R-2002	NS	4.11	NS	NS	NS
JONE-109-R-2002	1.89	3.22	23.63	0	0
JONE-110-R-2002	1.44	2.11	36.38	0	0
JONE-204-R-2002	2.56	3.89	12.23	0	0
JONE-213-R-2002	2.56	3.67	83.63	0	0
JONE-303-R-2002	3.00	3.44	99.97	0	0
JONE-312-R-2002	3.44	1.67	70.13	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
JONE-101-R-2002	1.84	44.24	53.12	0.81	0.46
JONE-102-R-2002	59.69	14.22	26.04	0.05	17.45
JONE-105-R-2002	77.70	4.05	18.02	0.23	24.07
JONE-107-R-2002	0.14	21.33	78.39	0.14	0.04
JONE-109-R-2002	41.17	19.87	38.73	0.23	12.20
JONE-110-R-2002	75.44	7.63	16.89	0.04	27.92
JONE-204-R-2002	1.17	42.19	55.12	1.52	0.29
JONE-213-R-2002	11.07	28.75	59.97	0.21	2.98
JONE-303-R-2002	15.42	30.02	52.77	1.79	4.83
JONE-312-R-2002	18.90	39.91	39.92	1.27	6.59

Interpretation of Watershed Condition

- Several sites with high urban land use and impervious surface
- Chloride elevated at most sites
- Nitrogen and phosphorus elevated at most sites
- Channelization and erosion are problematic throughout watershed

Jones Falls

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (μeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
JONE-101-R-2002	7.90	237.2	692.7	34.977	2.095	5.162	0.0089	0.0039	0.0027	0.0090	2.1129	1.1514	9.4	0.2
JONE-102-R-2002	7.79	633.9	1359.2	113.526	4.153	30.860	0.0264	0.0091	0.0285	0.0337	4.3326	8.2866	0.7	6.8
JONE-105-R-2002	7.71	450.9	1567.0	58.241	1.635	33.452	0.0443	0.0128	0.0267	0.0337	1.7103	4.1564	17.9	1.9
JONE-107-R-2002	7.04	92.4	488.0	5.067	0.604	4.942	0.0285	0.0028	0.0035	0.0087	0.7382	2.7094	NS	NS
JONE-109-R-2002	7.71	419.6	914.4	72.998	1.465	17.067	0.0224	0.0164	0.0021	0.0047	1.5339	1.6317	9.3	0
JONE-110-R-2002	7.72	938.1	1611.6	190.387	2.028	35.033	0.0206	0.0049	0.0129	0.0064	2.1304	2.1154	8.2	0.2
JONE-204-R-2002	7.80	236.5	693.8	35.613	2.050	5.063	0.0219	0.0038	0.0022	0.0085	2.0958	1.0585	9.3	33
JONE-213-R-2002	7.83	344.1	2300.5	22.140	2.045	6.483	0.0278	0.0193	0.0091	0.0119	2.0892	1.5006	8.8	3.9
JONE-303-R-2002	8.05	455.0	2195.5	59.648	1.672	12.732	0.0121	0.0007	0.0086	0.0251	1.7822	1.7515	7.2	5.7
JONE-312-R-2002	7.94	547.2	1541.9	96.526	1.144	15.969	0.0343	0.0032	0.0127	0.0507	1.2648	2.7334	7.4	3.8

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
JONE-105-R-2002	14	50	PV	LN	1	2	2	6	37	0	0	100	12	15	28
JONE-107-R-2002	50	40	FR	CP	NS	NS	NS	NS	NS	NS	NS	NS	NS	17	NS
JONE-109-R-2002	50	50	LN	OF	12	14	7	8	43	10	32	30	60	16	36
JONE-110-R-2002	35	30	HO	LN	13	13	8	8	42	14	33	20	90	10	40
JONE-204-R-2002	50	50	FR	FR	10	12	7	7	49	6	26	35	95	16	32
JONE-213-R-2002	50	50	FR	FR	17	18	13	13	44	16	31	35	90	17	51
JONE-303-R-2002	50	50	FR	FR	18	16	16	16	39	16	36	42	90	11	92
JONE-312-R-2002	0	0	RR	PV	17	14	17	16	60	16	50	55	60	1	89

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
JONE-101-R-2002	N	N	N	N	Mild	Mild	Mild
JONE-102-R-2002	Y	N	N	N	Severe	Severe	Severe
JONE-105-R-2002	Y	N	N	Y	None	None	None
JONE-107-R-2002	N	N	N	N	NS	NS	NS
JONE-109-R-2002	N	N	N	N	Severe	Moderate	Moderate
JONE-110-R-2002	N	N	N	Y	Mild	Severe	Severe
JONE-204-R-2002	N	N	N	N	Moderate	Moderate	Mild
JONE-213-R-2002	N	N	N	N	Moderate	Moderate	Mild
JONE-303-R-2002	N	N	N	N	Moderate	Moderate	Severe
JONE-312-R-2002	Y	N	N	Y	None	None	Moderate

Jones Falls

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BLUNTNOSE MINNOW
BROWN TROUT
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
GREEN SUNFISH
LARGEMOUTH BASS
LEPOMIS HYBRID
LONGNOSE DACE
MOSQUITOFISH
MUMMICHOG
NORTHERN HOGSUCKER
REDBREAST SUNFISH
ROCK BASS
ROSYSIDE DACE
SATINFIN SHINER
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACENTRELLA
AMELETUS
ANCHYTARSUS
ANTOCHA
BAETIDAE
BAETIS
CAECIDOTEA
CARDIOCLADIUS
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CHIRONOMINAE
CHIRONOMINI
CHRYSOPS
CLINOCERA
CONCHAPELOPIA
CORYNONEURA
CRANGONYCTIDAE
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
DIAMESA
DICROTENDIPES
DIPLECTRONA
DOLOPHILODES
DUGESIA
ELMIDAE
ENCHYTRAEIDAE
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GLOSSOSOMA
GLOSSOSOMATIDAE
HEMERODROMIA
HEPTAGENIIDAE
HYDROBAENUS
HYDROPSYCHE
HYDROPSYCHIDAE
LEPIDOPTERA
LEPTOPHLEBIIDAE
LEUCTRIDAE
LIMNOPHYES
LIMONIA
LIRCEUS
LUMBRICULIDAE
MEROPELOPIA
MICROPSECTRA
NAIDIDAE
NEOPHYLAX
NIGRONIA
OPTIOSERVUS
ORMOSIA
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARACLADOPELMA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PERLIDAE
PERLODIDAE
PHAENOPSECTRA
PHILOPOTAMIDAE
PHYSELLA
PLACOBDELLA
POLYPEDILUM
PROSIMULIUM
PROSTOMA
PSEPHENUS
PSEUDOLIMNOPHILA
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIMULIIDAE
SIMULIUM
SPHAERIIDAE
STEMPELLINELLA
STENELMIS
STENONEMA
SUBLETTEA
SYMPOTTHASTIA
TANYPODINAE
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TRIBELOS
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

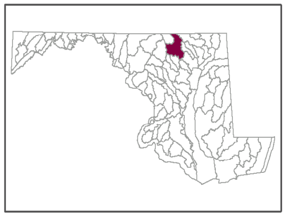
Herpetofauna Present

GREEN FROG
LONGTAIL SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
PICKEREL FROG
QUEEN SNAKE

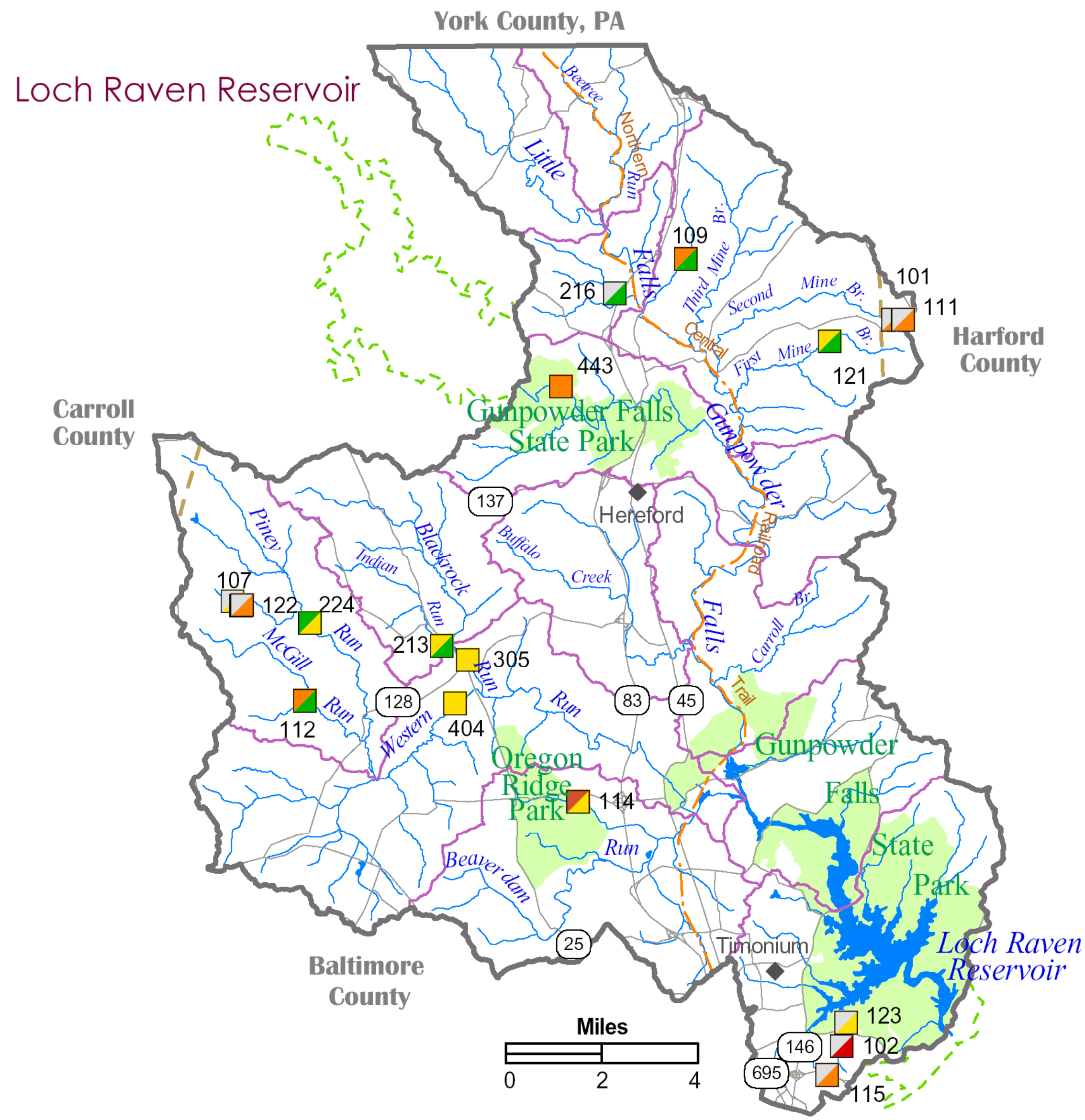
Jones Falls

Stream Waders Data

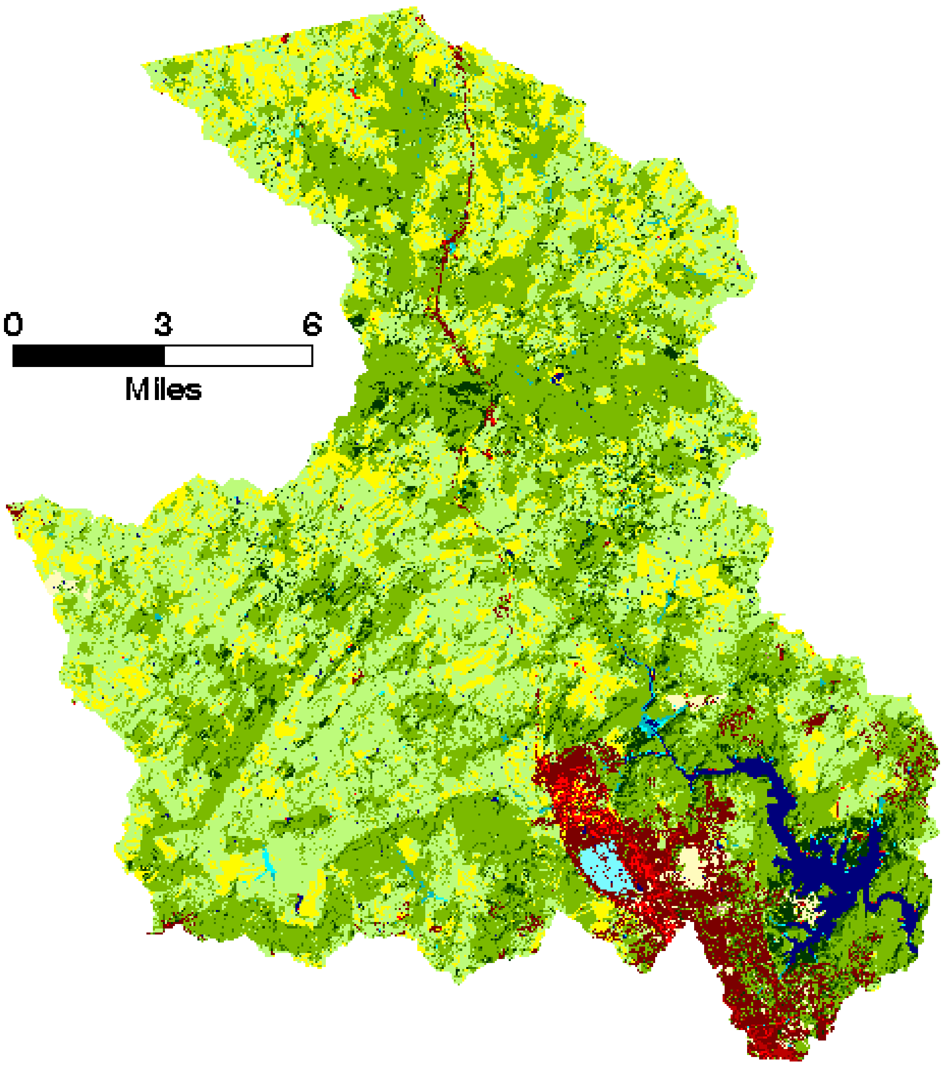
Site	8-Digit Watershed	Stream Name	Benthic IBI
1033-5	Jones Falls	Stoney Run	1.57
1032-1	Jones Falls	Jones Falls	1.29
1032-2	Jones Falls	Jones Falls	1.29
1032-3	Jones Falls	Jones Falls	1.57
1032-4	Jones Falls	Jones Falls	1.57
1033-1	Jones Falls	Stoney Run	1.29
1033-2	Jones Falls	Stoney Run	1.00
1033-3	Jones Falls	Stoney Run	1.29
1033-4	Jones Falls	Stoney Run	1.29
1035-1	Jones Falls	Western Run	1.29
1035-2	Jones Falls	Western Run	1.86
1035-3	Jones Falls	Western Run	2.14
1035-4	Jones Falls	Western Run	2.71
1035-5	Jones Falls	Western Run	2.43
1036-1	Jones Falls	Slaughterhouse Branch	3.57
1036-2	Jones Falls	Jones Falls	3.57
1036-3	Jones Falls	Jones Falls	5.00
1036-4	Jones Falls	Jones Falls	3.29
1036-5	Jones Falls	Jones Falls	2.71
1037-1	Jones Falls	Roland Run	2.43
1037-2	Jones Falls	Roland Run	1.86
1037-3	Jones Falls	Roland Run	2.43
1037-4	Jones Falls	Roland Run UT	1.57

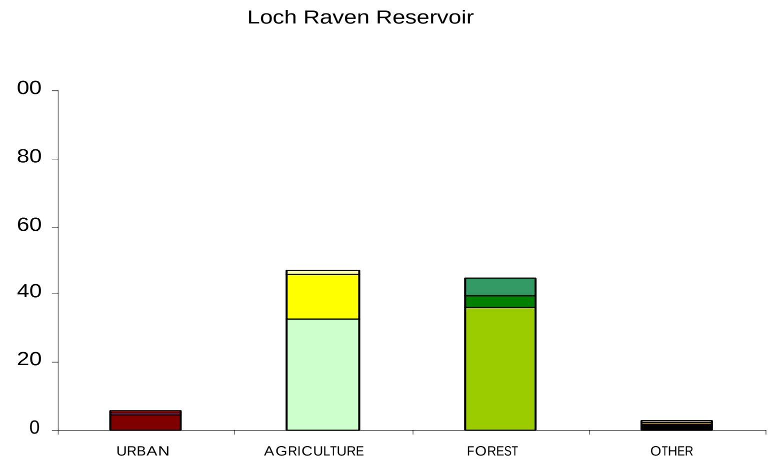


Loch Raven Reservoir watershed
MBSS 2002



Loch Raven Reservoir





Loch Raven Reservoir
Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LOCH-101-R-2002	Second Mine Br	021308050309	Loch Raven Reservoir	Gunpowder River	Harford	2-Apr-02	22-Jul-02	1	128
LOCH-102-R-2002	Loch Raven Res Ut	021308050300	Loch Raven Reservoir	Gunpowder River	Baltimore	4-Apr-02	17-Jun-02	1	225
LOCH-107-R-2002	Piney Run Ut 1	021308050308	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	27-Jun-02	1	299
LOCH-109-R-2002	Fourth Mine Br	021308050309	Loch Raven Reservoir	Gunpowder River	Baltimore	2-Apr-02	10-Jul-02	1	884
LOCH-111-R-2002	Second Mine Br	021308050309	Loch Raven Reservoir	Gunpowder River	Harford	2-Apr-02	22-Jul-02	1	86
LOCH-112-R-2002	Mcgill Run Ut	021308050308	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	19-Jun-02	1	708
LOCH-114-R-2002	Oregon Br	021308050302	Loch Raven Reservoir	Gunpowder River	Baltimore	4-Apr-02	6-Jun-02	1	1558
LOCH-115-R-2002	Long Quarter Br Ut	021308050300	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	5-Jun-02	1	125
LOCH-121-R-2002	First Mine Br	021308050309	Loch Raven Reservoir	Gunpowder River	Baltimore	2-Apr-02	22-Jul-02	1	1086
LOCH-122-R-2002	Piney Run Ut 1	021308050308	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	27-Jun-02	1	410
LOCH-123-R-2002	Loch Raven Res Ut	021308050300	Loch Raven Reservoir	Gunpowder River	Baltimore	4-Apr-02	13-Jun-02	1	538
LOCH-213-R-2002	Indian Run	021308050307	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	30-Jul-02	2	2402
LOCH-216-R-2002	Owl Branch Ut	021308050310	Loch Raven Reservoir	Gunpowder River	Baltimore	2-Apr-02	10-Jul-02	2	853
LOCH-224-R-2002	Piney Run	021308050308	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	30-Jul-02	2	5839
LOCH-305-R-2002	Blackrock Run	021308050303	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	29-Jul-02	3	8875
LOCH-404-R-2002	Western Run	021308050303	Loch Raven Reservoir	Gunpowder River	Baltimore	3-Apr-02	29-Jul-02	4	24284
LOCH-443-R-2002	Gunpowder Falls	021308050306	Loch Raven Reservoir	Gunpowder River	Baltimore	2-Apr-02	25-Jul-02	4	1121

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
LOCH-101-R-2002	NR	2.33	12.01	0	0
LOCH-102-R-2002	NR	1.89	23.12	0	0
LOCH-107-R-2002	NR	3.89	2.86	0	0
LOCH-109-R-2002	2.78	4.56	49.33	0	0
LOCH-111-R-2002	NS	2.33	NS	NS	NS
LOCH-112-R-2002	2.33	4.11	43.13	0	0
LOCH-114-R-2002	1.67	3.89	29.61	0	0
LOCH-115-R-2002	NR	2.33	27.12	0	0
LOCH-121-R-2002	3.00	4.11	85.85	0	1
LOCH-122-R-2002	1.22	3.22	3.41	0	0
LOCH-123-R-2002	NR	3.00	67.04	0	0
LOCH-213-R-2002	3.89	4.11	95.08	0	1
LOCH-216-R-2002	NR	4.56	35.91	0	1
LOCH-224-R-2002	4.11	3.67	94.47	0	0
LOCH-305-R-2002	3.67	3.67	72.63	0	0
LOCH-404-R-2002	3.44	3.67	93.45	0	0
LOCH-443-R-2002	2.78	2.56	100.00	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
LOCH-101-R-2002	0.35	89.22	9.22	1.22	0.09
LOCH-102-R-2002	45.54	4.85	49.50	0.10	12.92
LOCH-107-R-2002	0.07	83.21	16.64	0.07	0.02
LOCH-109-R-2002	0.81	67.56	31.54	0.10	0.34
LOCH-111-R-2002	0.26	86.86	12.89	0.00	0.06
LOCH-112-R-2002	0.00	61.72	38.06	0.22	0.00
LOCH-114-R-2002	0.01	47.87	51.52	0.60	0.01
LOCH-115-R-2002	48.57	11.61	39.82	0.00	13.04
LOCH-121-R-2002	0.12	71.42	27.80	0.65	0.07
LOCH-122-R-2002	0.11	85.09	14.69	0.11	0.05
LOCH-123-R-2002	35.55	4.80	59.64	0.00	9.12
LOCH-213-R-2002	0.03	62.79	36.74	0.44	0.02
LOCH-216-R-2002	0.05	39.05	60.66	0.23	0.01
LOCH-224-R-2002	0.75	74.38	24.57	0.30	0.26
LOCH-305-R-2002	0.09	62.82	36.70	0.40	0.03
LOCH-404-R-2002	0.51	59.78	39.18	0.53	0.16
LOCH-443-R-2002	0.00	16.41	83.37	0.22	0.00

Loch Raven Reservoir

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LOCH-101-R-2002	6.90	217.2	592.0	25.839	4.895	10.059	0.1213	0.0210	0.0493	0.1128	5.4720	2.7043	3.2	6.3
LOCH-102-R-2002	8.06	706.5	5335.7	49.611	1.552	17.745	0.0092	0.0007	0.0026	0.0088	1.6421	2.5509	7.5	1
LOCH-107-R-2002	6.91	133.4	379.3	13.697	3.824	4.188	0.5196	0.0082	0.0268	0.1609	4.1469	2.7448	4.8	222
LOCH-109-R-2002	7.20	236.2	469.2	42.996	2.664	4.744	0.0166	0.0089	0.0036	0.0105	2.7182	1.0369	9	3.9
LOCH-111-R-2002	6.45	321.2	775.2	53.911	2.015	8.198	0.4332	0.0272	0.0293	0.4265	4.8601	3.7248	NS	NS
LOCH-112-R-2002	7.41	140.3	410.3	13.177	3.129	8.443	0.0200	0.0080	0.0043	0.0141	3.1997	1.3940	8.3	1.3
LOCH-114-R-2002	8.05	392.7	2290.4	37.618	2.195	8.450	0.0156	0.0025	0.0082	0.0211	2.2708	1.6964	7.5	1.5
LOCH-115-R-2002	7.93	1047.4	4357.4	177.009	0.419	27.908	0.0061	0.0007	0.0036	0.0144	0.5195	1.8240	6.6	1.7
LOCH-121-R-2002	7.19	189.1	548.2	18.842	4.138	13.650	0.0687	0.0569	0.0177	0.0196	4.1386	1.6384	7.2	11.8
LOCH-122-R-2002	7.07	153.2	402.7	16.212	4.476	5.521	0.0541	0.0037	0.0163	0.0371	4.5451	2.1538	5	18.7
LOCH-123-R-2002	8.21	708.5	4910.8	58.089	2.309	18.223	0.0089	0.0007	0.0042	0.0095	2.3482	1.6746	7.7	2.3
LOCH-213-R-2002	7.71	242.2	904.5	30.956	2.480	6.318	0.0123	0.0032	0.0062	0.0218	2.5740	1.1395	6.9	1.4
LOCH-216-R-2002	7.23	137.2	356.8	22.117	1.766	3.890	0.0089	0.0007	0.0006	0.0161	1.9071	1.1413	8.4	1.7
LOCH-224-R-2002	7.74	268.8	643.9	34.920	5.795	9.032	0.0334	0.0161	0.0131	0.0235	5.9155	1.8215	8.5	3
LOCH-305-R-2002	7.84	227.4	843.9	28.369	2.712	6.897	0.0118	0.0007	0.0081	0.0091	2.6553	1.7514	8	3.9
LOCH-404-R-2002	7.84	292.8	1630.1	24.032	3.173	9.348	0.0262	0.0031	0.0167	0.0278	3.2986	1.6793	7.1	9
LOCH-443-R-2002	7.75	154.3	504.6	21.355	1.735	6.094	0.0201	0.0007	0.0171	0.0208	1.9494	1.7981	10.7	0.9

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
LOCH-101-R-2002	8	35	CP	CP	8	8	6	7	36	7	39	40	99	14	25
LOCH-102-R-2002	40	50	HO	FR	11	11	11	11	59	7	16	9	81	9	50
LOCH-107-R-2002	0	0	PA	PA	3	3	6	6	52	6	23	85	20	17	22
LOCH-109-R-2002	50	50	FR	FR	14	14	9	10	59	10	16	40	70	17	38
LOCH-111-R-2002	0	0	PA	PA	NS	NS	NS	NS	NS	NS	NS	NS	NS	14	NS
LOCH-112-R-2002	50	50	FR	FR	15	18	9	7	24	11	51	17	97	16	26
LOCH-114-R-2002	50	50	OF	OF	15	12	11	14	65	7	13	55	95	10	55
LOCH-115-R-2002	50	50	FR	FR	12	11	11	11	60	6	15	35	90	4	53
LOCH-121-R-2002	50	50	FR	FR	18	18	12	14	52	10	23	21	79	17	71
LOCH-122-R-2002	0	0	PA	PA	4	5	6	5	50	7	25	90	30	17	19
LOCH-123-R-2002	50	50	FR	FR	10	8	11	11	50	9	25	40	90	8	54
LOCH-213-R-2002	50	10	FR	CP	18	18	14	13	55	10	25	10	77	18	43
LOCH-216-R-2002	50	50	FR	OF	16	13	9	10	42	12	33	65	98	17	30
LOCH-224-R-2002	5	5	PA	DI	16	14	17	17	60	16	26	0	86	18	84
LOCH-305-R-2002	50	50	LN	LN	18	17	13	15	45	13	35	35	80	16	54
LOCH-404-R-2002	50	50	OF	LN	16	17	16	14	62	17	17	8	75	16	63
LOCH-443-R-2002	50	50	FR	FR	17	16	16	16	45	16	60	35	70	16	81

Loch Raven Reservoir

Physical Habitat Modifications

LOCH-101-R-2002	N	N	N	N	Mild	Moderate	Moderate
LOCH-102-R-2002	Y	N	N	Y	None	None	Mild
LOCH-107-R-2002	Y	N	N	N	Severe	Severe	Moderate
LOCH-109-R-2002	N	N	N	N	Moderate	Moderate	Moderate
LOCH-111-R-2002	N	N	N	N	NS	NS	NS
LOCH-112-R-2002	Y	N	N	N	Moderate	Moderate	Moderate
LOCH-114-R-2002	N	N	N	N	Severe	Severe	Mild
LOCH-115-R-2002	Y	N	N	N	Severe	Severe	Severe
LOCH-121-R-2002	N	N	N	N	Severe	Moderate	Moderate
LOCH-122-R-2002	Y	N	N	N	Moderate	Moderate	Mild
LOCH-123-R-2002	N	N	N	N	Moderate	Moderate	Moderate
LOCH-213-R-2002	N	N	N	N	Severe	Moderate	Mild
LOCH-216-R-2002	N	N	N	N	Moderate	Moderate	Mild
LOCH-224-R-2002	Y	N	N	Y	None	None	Mild
LOCH-305-R-2002	N	N	N	N	Mild	Moderate	Mild
LOCH-404-R-2002	N	N	N	N	Moderate	Severe	Mild
LOCH-443-R-2002	Y	N	N	N	Mild	Mild	Mild

Interpretation of Watershed Condition

- Several sites highly urban; several other sites highly agricultural
- Chloride elevated at many sites
- Nitrogen and phosphorus elevated at many sites
- Turbidity very high at site 109
- Erosion a problem throughout watershed

Loch Raven Reservoir

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BLUNTNOSE MINNOW
BROOK TROUT
BROWN BULLHEAD
BROWN TROUT
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
GREEN SUNFISH
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
PUMPKINSEED
RAINBOW TROUT
RIVER CHUB
ROSYFACE SHINER
ROSYSIDE DACE
SATINFIN SHINER
SHIELD DARTER
SMALLMOUTH BASS
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

BAMBOO
JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ACENTRELLA
AGABUS
ALLOPERLA
AMELETUS
AMPHINEMURA
AMPHIPODA
ANCHYTARSUS
ANTOCHA
BAETIDAE
BAETIS
CAECIDOTEA
CALOPTERYX
CAMBARIDAE
CAPNIIDAE
CERATOPOGONIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINAE
CHIRONOMINI
CHLOROPERLIDAE
CHRYSOPS
CLADOTANYTARSUS
CLINOCERA
CLINOTANYPUS
CONCHAPELOPIA
CORYNONEURA
CRANGONYX
CRICOTOPUS
CRICOTOPUS/ORTHOCLADIUS
CRYPTOCHIRONOMUS
DIAMESA
DIAMESINAE
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DIPTERA
DIXA
DOLOPHILODES
DRUNELLA
DUGESIA
DYTISCIDAE
ECCOPTURA
ECTOPRIA
ELMIDAE
ENCHYTRAEIDAE
EPEORUS
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
GAMMARUS
GLOSSOSOMATIDAE
GOMPHIDAE
GORDIIDAE
HELENIELLA
HEMERODROMIA
HEPTAGENIIDAE
HEXATOMA
HYDROBAENUS
HYDROPSYCHE
HYDROPSYCHIDAE
ISONYCHIA
ISOPERLA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCOTRICHIA
LEUCTRA
LEUCTRIDAE
LIMNODRILUS
LIRCEUS
LUMBRICULIDAE
LYPE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MOLANNA
NAIDIDAE
NANOCLADIUS
NATARSIA
NEOPHYLAX
NIGRONIA
OLIGOCHAETA
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PERICOMA
PERLESTA
PERLIDAE
PERLODIDAE
PHILOPOTAMIDAE
PHYSELLA
PISIDIUM
PLANARIIDAE
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PRODIAMESA
PROSIMULIUM
PROSTOIA
PROSTOMA
PSEPHENUS
PSEUDOCHIRONOMUS
PSEUDOLIMNOPHILA
PSEUDOSUCCINEA
PTYCHOPTERA
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIALIS
SIMULIIDAE
SIMULIUM
SPHAERIIDAE
SPHAERIUM
SPIROSPERMA
STAGNICOLA
STEMPELLINELLA
STENACRON
STENELMIS
STENONEMA

Loch Raven Reservoir

Benthic Taxa Present (Con’t)

STYGONECTES
SYMPOSIOCLADIUS
SYMPOTTHASTIA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

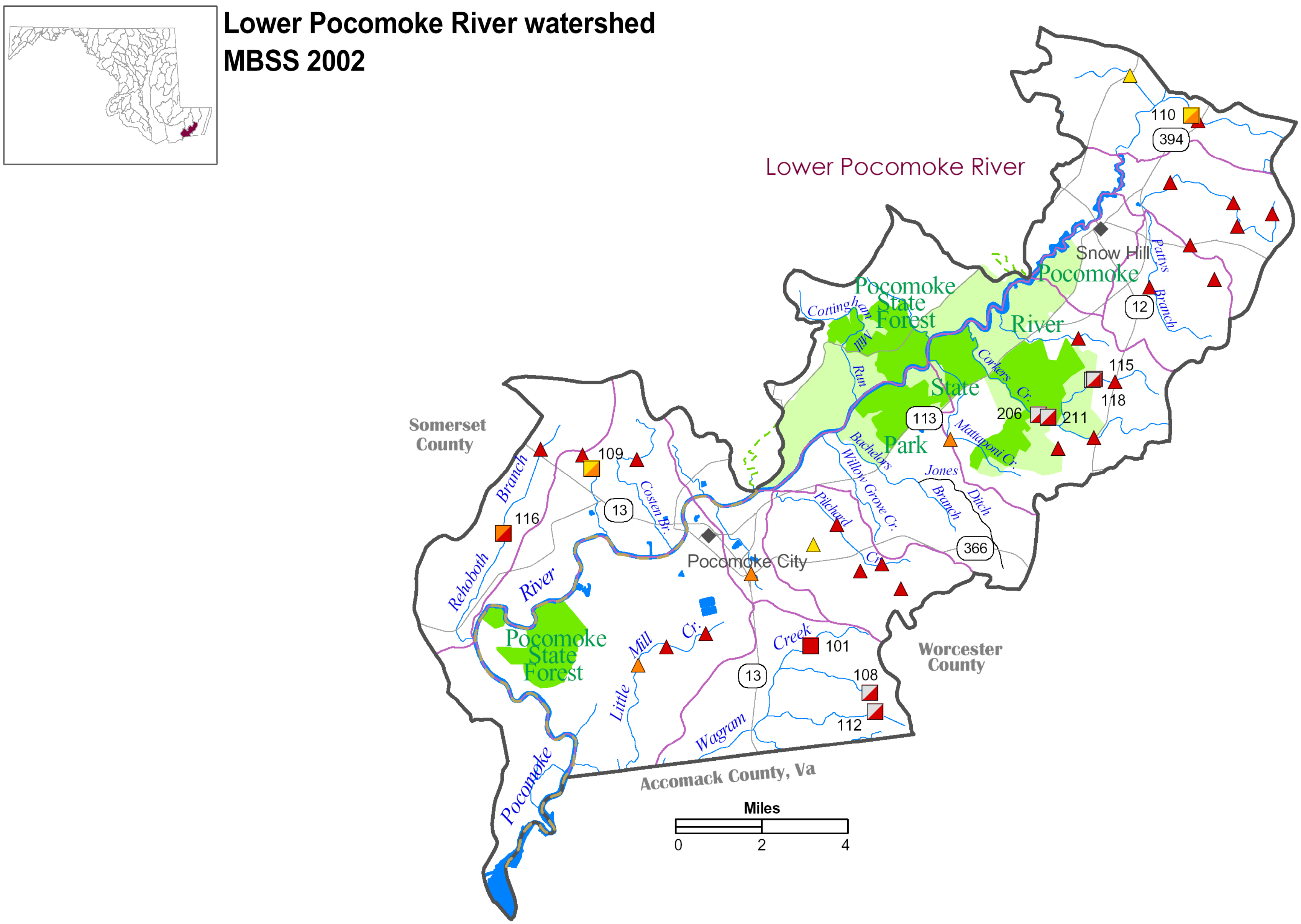
Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON SNAPPING TURTLE
FOWLER’S TOAD
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
QUEEN SNAKE
RED SALAMANDER
WOOD FROG

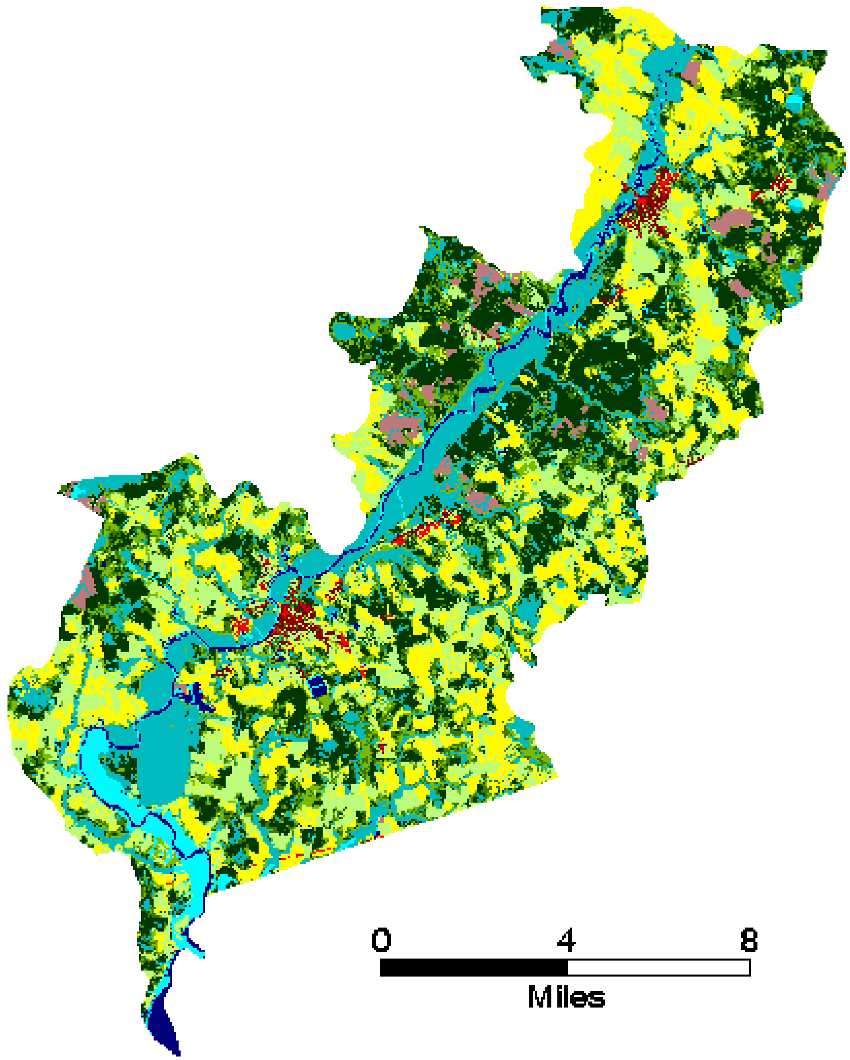
Loch Raven Reservoir

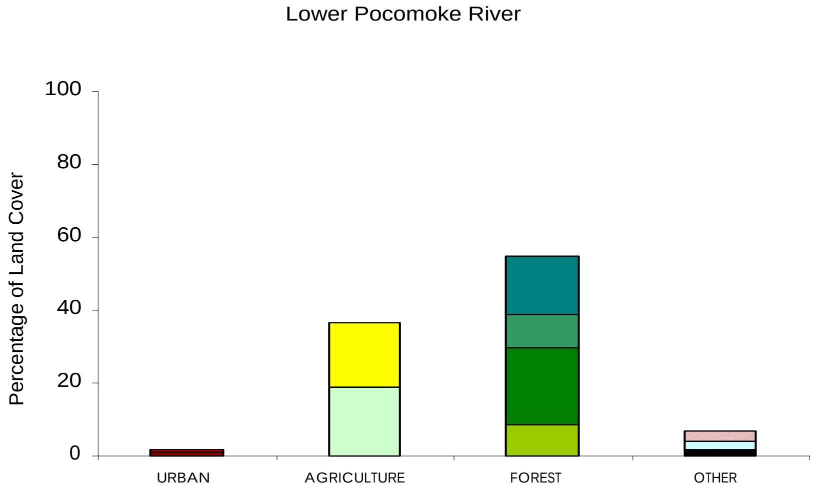
Stream Waders Data
No stream waders data collected in 2002

Lower Pocomoke River watershed
MBSS 2002



Lower Pocomoke





Lower Pocomoke

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LOPC-101-R-2002	Wagram Swamp Br	021302020628	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	3-Jun-02	1	807
LOPC-108-R-2002	Wagram Cr	021302020628	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	3-Jun-02	1	235
LOPC-109-R-2002	Puncheon Landing	021302020627	Lower Pocomoke River	Pocomoke River	Somerset	12-Mar-02	4-Jun-02	1	353
LOPC-110-R-2002	Poorhouse Br	021302020639	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	3-Jun-02	1	1616
LOPC-112-R-2002	Wagram Cr Ut 1	021302020628	Lower Pocomoke River	Pocomoke River	Worceste	12-Mar-02	3-Jun-02	1	294
LOPC-115-R-2002	Kelly Mill Br	021302020633	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	3-Jun-02	1	1078
LOPC-116-R-2002	Rehobeth Br	021302020625	Lower Pocomoke River	Pocomoke River	Somerset	12-Mar-02	5-Jun-02	1	3675
LOPC-118-R-2002	Kelly Mill Br	021302020633	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	3-Jun-02	1	1137
LOPC-206-R-2002	Corkers Cr	021302020633	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	4-Jun-02	2	5087
LOPC-211-R-2002	Corkers Cr	021302020633	Lower Pocomoke River	Pocomoke River	Worceste	11-Mar-02	4-Jun-02	2	4959

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
LOPC-101-R-2002	1.00	1.86	28.77	0	0
LOPC-108-R-2002	NR	1.57	20.64	0	0
LOPC-109-R-2002	3.50	2.43	62.32	0	0
LOPC-110-R-2002	3.75	2.43	75.80	0	0
LOPC-112-R-2002	NS	1.86	NS	NS	NS
LOPC-115-R-2002	NR	1.57	7.72	1	0
LOPC-116-R-2002	2.00	1.57	13.04	0	0
LOPC-118-R-2002	NR	1.57	23.28	1	0
LOPC-206-R-2002	NR	1.86	14.75	1	0
LOPC-211-R-2002	NS	1.86	29.00	NS	NS

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
LOPC-101-R-2002	0.03	59.69	40.06	0.22	0.02
LOPC-108-R-2002	0.00	30.41	69.59	0.00	0.00
LOPC-109-R-2002	0.00	44.55	51.04	4.41	0.00
LOPC-110-R-2002	0.03	35.93	61.08	2.96	0.01
LOPC-112-R-2002	0.61	39.53	59.86	0.00	0.46
LOPC-115-R-2002	0.00	57.20	42.72	0.08	0.00
LOPC-116-R-2002	0.04	21.72	70.18	8.07	0.03
LOPC-118-R-2002	0.00	57.68	42.24	0.08	0.00
LOPC-206-R-2002	0.47	44.42	51.79	3.32	0.13
LOPC-211-R-2002	0.48	44.88	51.24	3.41	0.13

Interpretation of Watershed Condition

- Low ANC values throughout watershed
- Sulfate, phosphorus and ammonia values elevated
- Low dissolved oxygen and high DOC values indicative of natural, swampy conditions
- Turbidity high at several sites
- Several sites with no riparian buffer; physical habitat variables general poor
- Channelization problematic throughout watershed

Lower Pocomoke

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (μeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LOPC-101-R-2002	4.01	251.3	-107.3	13.034	0.052	79.333	0.0100	0.0007	0.0004	0.1472	0.2394	1.4600	7.5	0.6
LOPC-108-R-2002	5.41	252.6	56.1	19.976	0.389	65.598	0.0304	0.0007	0.0045	0.0301	0.7012	6.3649	5.6	82.4
LOPC-109-R-2002	6.31	320.8	331.2	31.275	0.410	72.943	0.0933	0.0074	0.0085	0.0712	0.9642	9.3196	3.6	42
LOPC-110-R-2002	6.30	251.4	262.1	20.538	11.042	23.418	0.0121	0.0042	0.0148	0.0083	11.0390	1.5636	5.4	1.5
LOPC-112-R-2002	5.01	332.2	-5.2	25.792	0.372	90.244	0.1325	0.0031	0.0026	0.0354	0.6794	5.7958	NS	NS
LOPC-115-R-2002	6.95	278.5	85.6	27.031	1.343	63.408	0.1495	0.0231	0.0114	0.0253	1.8720	11.4344	7.2	19.5
LOPC-116-R-2002	6.16	253.1	271.8	30.505	0.542	44.203	0.1028	0.0148	0.0084	0.0665	0.9046	7.9977	4.5	29.5
LOPC-118-R-2002	6.81	281.6	89.9	29.602	1.322	70.277	0.1844	0.0241	0.0108	0.0215	1.9166	11.3022	8.2	19.5
LOPC-206-R-2002	5.87	278.9	104.7	25.667	0.001	67.044	0.0340	0.0089	0.0009	0.0135	0.3430	8.3926	4.1	18.4
LOPC-211-R-2002	5.81	280.3	110.8	28.859	0.001	66.081	0.0330	0.0089	0.0006	0.0132	0.3314	8.6816	4.8	15.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
LOPC-101-R-2002	32	50	PV	FR	11	12	5	9	60	12	15	100	95	19	33
LOPC-108-R-2002	0	0	CP	CP	12	6	4	6	75	0	0	100	25	16	38
LOPC-109-R-2002	0	0	CP	CP	11	4	9	11	74	1	1	95	35	12	131
LOPC-110-R-2002	50	50	FR	FR	15	14	10	14	60	6	16	85	90	17	74
LOPC-112-R-2002	0	0	CP	CP	NS	NS	NS	NS	NS	NS	NS	NS	NS	15	NS
LOPC-115-R-2002	0	50	CP	FR	6	6	3	4	60	6	15	100	85	16	25
LOPC-116-R-2002	25	50	CP	FR	5	5	4	8	72	1	3	100	90	16	38
LOPC-118-R-2002	0	40	CP	CP	10	12	5	9	75	0	0	100	80	16	32
LOPC-206-R-2002	50	50	FR	FR	8	8	3	7	73	6	2	100	97	19	26
LOPC-211-R-2002	50	50	FR	FR	10	8	5	10	75	0	0	100	95	19	34

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LOPC-101-R-2002	N	N	N	Y	None	None	Mild
LOPC-108-R-2002	Y	N	N	Y	None	None	None
LOPC-109-R-2002	N	N	N	Y	None	None	Moderate
LOPC-110-R-2002	N	N	N	N	Mild	Mild	Mild
LOPC-112-R-2002	Y	N	N	Y	NS	NS	NS
LOPC-115-R-2002	Y	N	N	Y	None	None	Moderate
LOPC-116-R-2002	Y	N	N	Y	Mild	None	Moderate
LOPC-118-R-2002	Y	N	N	Y	Mild	Mild	Mild
LOPC-206-R-2002	N	N	N	N	None	None	Mild
LOPC-211-R-2002	N	N	N	N	None	None	Mild

Lower Pocomoke

Fish Species Present

AMERICAN EEL
BANDED SUNFISH
BLUEGILL
BLUESPOTTED SUNFISH
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUBSUCKER
EASTERN MUDMINNOW
ENNEACANTHUS SP
GOLDEN SHINER
LEAST BROOK LAMPREY
MUD SUNFISH
PIRATE PERCH
PUMPKINSEED
REDFIN PICKEREL
SWAMP DARTER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
AGABETES
AGABUS
AMNICOLA
APSECTROTANYPUS
CAECIDOTEA
CERATOPOGONIDAE
CHAETOCLADIUS
CHIRONOMIDAE
CHIRONOMINI
CHRYSOPS
CLINOTANYPUS
CONCHAPELOPIA
CORDULIIDAE
CORIXIDAE
CORYNONEURA
CRANGONYX
CULICOIDES
DICROTENDIPES
DIPLOCLADIUS
DIPTERA
DYTISCIDAE
ENDOCHIRONOMUS
EURYLOPHELLA
GAMMARUS
GORDIIDAE
HYDROBAENUS
HYDROPHILIDAE
HYDROPORUS
IRONOQUIA
ISOTOMIDAE
ISOTOMURUS
KIEFFERULUS
LEPIDOPTERA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LIMNEPHILIDAE
LIMNODRILUS
LIMNOPHYES
LUMBRICULIDAE
MENETUS
MEROPELOPIA
MESOCRICOTOPUS
MICROTENDIPES
NAIDIDAE
NANOCLADIUS
NATARSIA
NEMOURIDAE
NOTONECTA
ORTHOCLADIINAE
ORTHOCLADIUS
PARAMERINA
PARAMETRIOCNEMUS
PARANEMOURA
PARAPHAENOCLADIUS
PARATENDIPES
PELTODYTES
PHAENOPSECTRA
PHYSELLA
PISIDIUM
PLATHEMIS
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PROSTOIA
PROSTOMA
PSEUDOLIMNOPHILA
PYCNOPSYCHE
SCIOMYZIDAE
SIMULIIDAE
SIMULIUM
SMITTIA
SPHAERIIDAE
SPHAERIUM
SPHAEROMIAS
SPIROSPERMA
STAGNICOLA
STEGOPTERNA
STENOCHIRONOMUS
SYNURELLA
TABANIDAE
TABANUS
TANYPODINAE
TANYTARSUS
TIPULA
TIPULIDAE
TRIBELOS
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

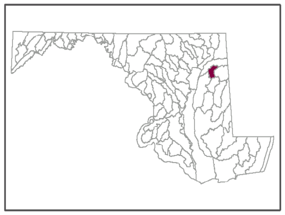
Herpetofauna Present

BULLFROG
COMMON SNAPPING TURTLE
EASTERN PAINTED TURTLE
FROG (UNKNOWN)
GREEN FROG
PICKEREL FROG
SOUTHERN LEOPARD FROG

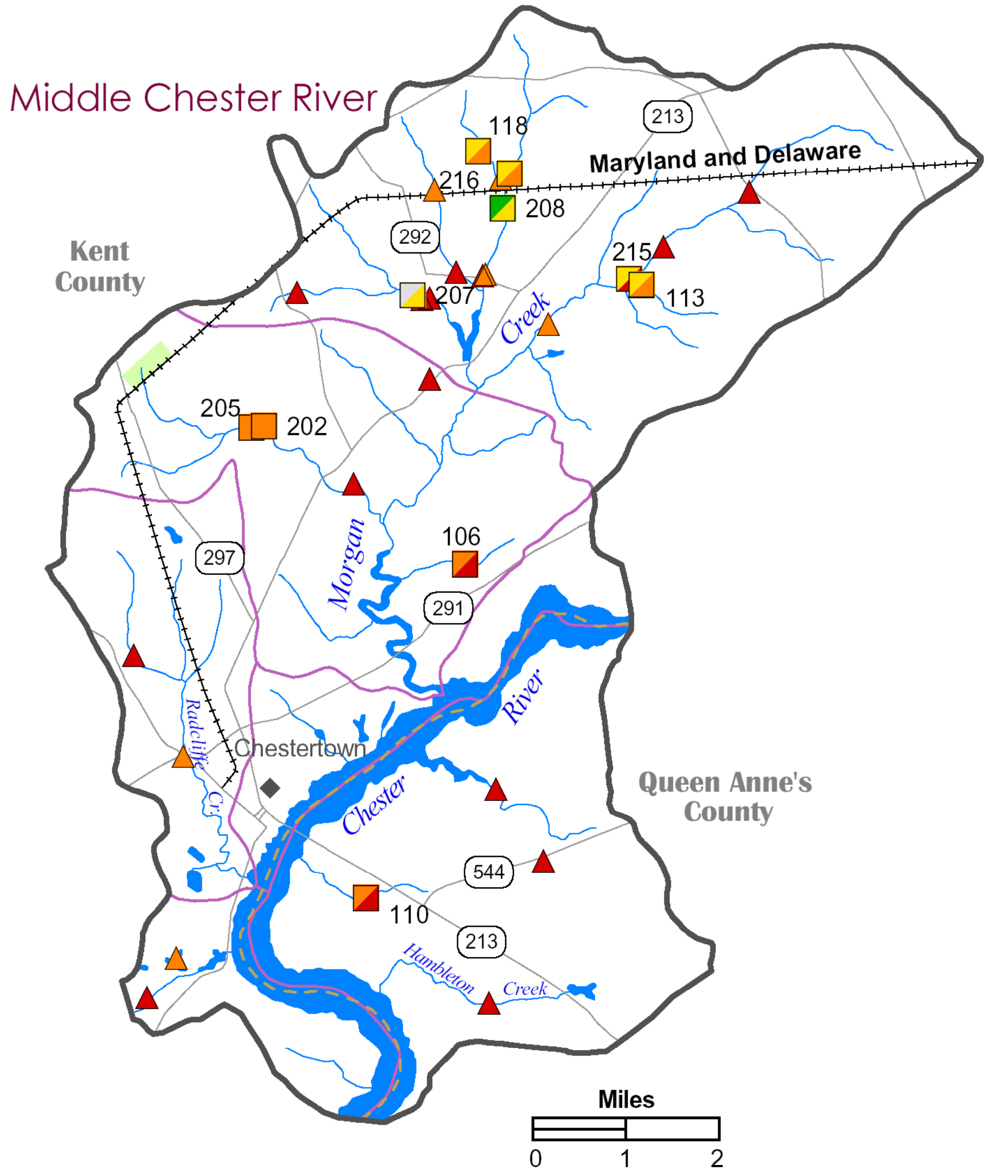
Lower Pocomoke

Stream Waders Data

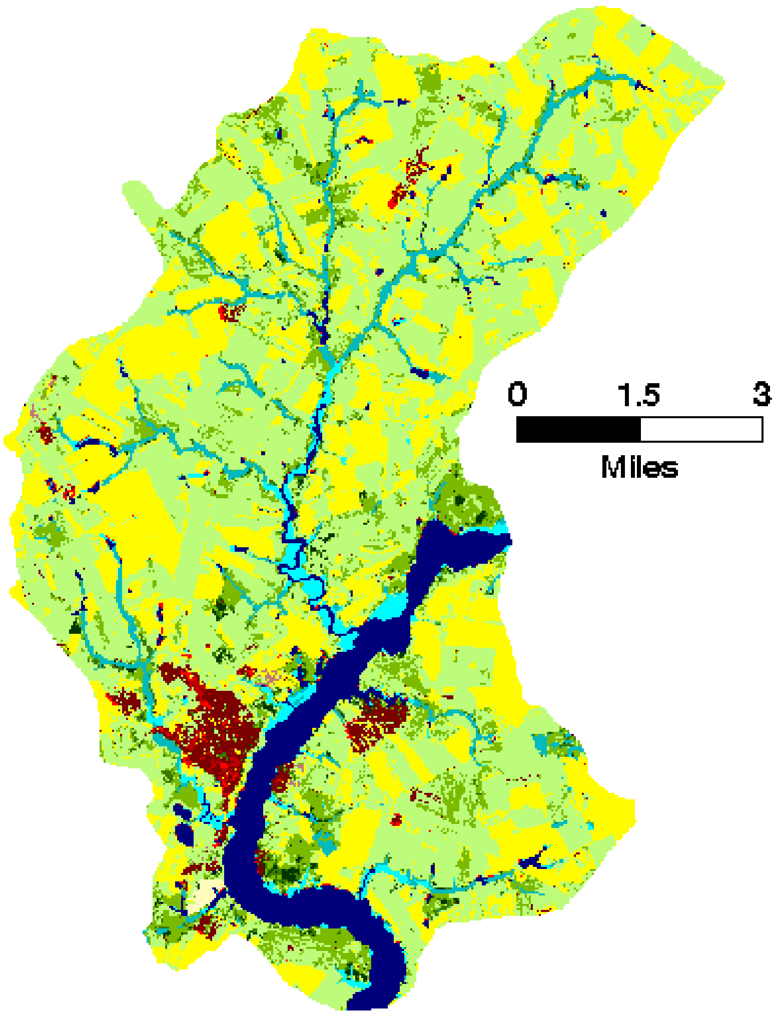
Site	8-Digit Watershed	Stream Name	Benthic IBI
625-1	Lower Pocomoke River	Rehoboth Branch	1.57
626-1	Lower Pocomoke River	Little Mill Creek	1.86
626-2	Lower Pocomoke River	Little Mill Creek	2.71
626-3	Lower Pocomoke River	Little Mill Creek	1.57
627-1	Lower Pocomoke River	Landing Branch	1.00
627-2	Lower Pocomoke River	Costen Branch	1.57
629-1	Lower Pocomoke River	Pocomoke River UT	2.14
631-1	Lower Pocomoke River	Redden Creek	1.29
631-2	Lower Pocomoke River	Goodwill Ditch	1.57
631-3	Lower Pocomoke River	Pilchard Creek	1.86
631-4	Lower Pocomoke River	Pilchard Creek UT	3.00
631-5	Lower Pocomoke River	Pilchard Creek	1.29
633-1	Lower Pocomoke River	Mattaponi Creek	2.71
633-2	Lower Pocomoke River	Hardship Branch	1.29
633-3	Lower Pocomoke River	Kelly Mill Branch	1.57
633-4	Lower Pocomoke River	Spring Hill Branch	1.57
633-5	Lower Pocomoke River	Tarr Branch	1.29
635-1	Lower Pocomoke River	Pattys Branch UT	1.86
635-2	Lower Pocomoke River	Pattys Branch	1.86
638-1	Lower Pocomoke River	Purnell Branch	1.29
638-2	Lower Pocomoke River	Campground Branch	1.57
638-3	Lower Pocomoke River	Campground Branch	1.29
638-4	Lower Pocomoke River	Campground Branch	1.57
638-5	Lower Pocomoke River	Campground Branch	1.29
639-2	Lower Pocomoke River	Poorhouse Branch	1.86
639-3	Lower Pocomoke River	Acquango Branch	3.00

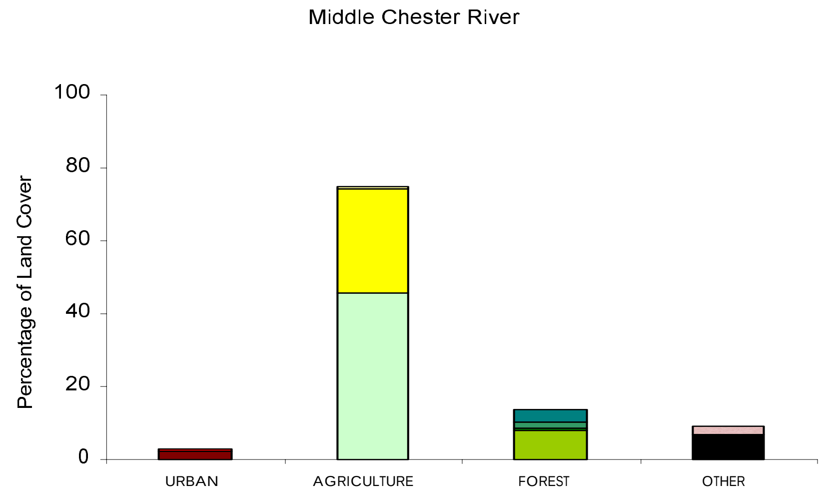


Middle Chester River watershed
MBSS 2002



Middle Chester River





Middle Chester River

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
MICR-106-R-2002	Morgan Cr Ut 5	021305090414	Middle Chester River	Chester River	Kent	26-Mar-02	30-Jul-02	1	558
MICR-110-R-2002	Chester R Ut 1	021305090412	Middle Chester River	Chester River	Queen Annes	28-Mar-02	19-Jun-02	1	614
MICR-113-R-2002	Morgan Cr Ut 4	021305090415	Middle Chester River	Chester River	Kent	1-Apr-02	10-Jun-02	1	520
MICR-118-R-2002	Morgan Cr Ut 1_Ut3	021305090415	Middle Chester River	Chester River	Kent	2-Apr-02	30-Jul-02	1	366
MICR-202-R-2002	Morgan Cr Ut 2	021305090414	Middle Chester River	Chester River	Kent	26-Mar-02	20-Jun-02	2	2060
MICR-205-R-2002	Morgan Cr Ut 2	021305090414	Middle Chester River	Chester River	Kent	26-Mar-02	20-Jun-02	2	1535
MICR-207-R-2002	Morgan Cr Ut1_Ut2	021305090415	Middle Chester River	Chester River	Kent	26-Mar-02	20-Jun-02	2	1603
MICR-208-R-2002	Morgan Cr Ut 1	021305090415	Middle Chester River	Chester River	Kent	26-Mar-02	7-Aug-02	2	2360
MICR-215-R-2002	Morgan Cr	021305090415	Middle Chester River	Chester River	Kent	2-Apr-02	10-Jun-02	2	4698
MICR-216-R-2002	Morgan Cr Ut 1	021305090415	Middle Chester River	Chester River	Kent	2-Apr-02	8-Aug-02	2	1714

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
MICR-106-R-2002	2.50	1.86	63.86	0	0
MICR-110-R-2002	2.25	1.29	31.56	0	0
MICR-113-R-2002	3.00	2.43	13.55	0	0
MICR-118-R-2002	3.00	2.71	26.57	0	0
MICR-202-R-2002	2.75	2.43	66.85	0	0
MICR-205-R-2002	2.25	2.43	63.09	0	0
MICR-207-R-2002	NS	3.29	NS	NS	NS
MICR-208-R-2002	4.00	3.29	89.09	0	0
MICR-215-R-2002	3.50	1.86	70.63	0	0
MICR-216-R-2002	3.25	2.71	50.47	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
MICR-106-R-2002	0.52	85.62	13.70	0.16	0.13
MICR-110-R-2002	3.80	80.36	15.70	0.14	1.20
MICR-113-R-2002	0.81	92.86	5.64	0.68	0.27
MICR-118-R-2002	1.09	74.62	23.07	1.21	0.30
MICR-202-R-2002	1.85	86.33	8.61	3.22	0.83
MICR-205-R-2002	2.44	85.56	8.15	3.86	1.09
MICR-207-R-2002	1.61	83.96	14.19	0.24	0.65
MICR-208-R-2002	0.60	82.88	15.57	0.94	0.28
MICR-215-R-2002	0.34	89.67	8.99	1.00	0.16
MICR-216-R-2002	0.58	86.93	11.52	0.96	0.31

Interpretation of Watershed Condition

- Highly agricultural watershed with elevated nitrogen and phosphorus throughout

Middle Chester River

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (μeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
MICR-106-R-2002	5.66	101.5	179.2	10.427	3.563	3.528	0.0228	0.0111	0.0055	0.0450	3.6708	2.0540	5.7	2.7
MICR-110-R-2002	6.71	381.8	643.6	87.235	0.001	3.453	0.0900	0.0041	0.0006	0.0720	0.6448	8.5027	2.9	16
MICR-113-R-2002	7.16	173.6	676.1	15.822	2.204	8.626	0.0537	0.0078	0.0158	0.0429	2.4075	4.7226	6	13.8
MICR-118-R-2002	6.98	204.6	503.8	21.069	7.520	6.668	0.0356	0.0124	0.0154	0.0164	7.7257	2.6342	6.9	4.1
MICR-202-R-2002	8.57	366.5	1893.6	25.553	4.486	15.634	0.7251	0.3028	0.0574	0.2694	6.1844	5.9835	7.2	8.5
MICR-205-R-2002	9.08	480.7	2958.9	31.598	3.237	14.926	1.0372	0.4918	0.0790	0.4239	5.4183	9.0337	9.4	10.3
MICR-207-R-2002	7.06	183.5	567.6	15.089	6.713	5.072	0.0855	0.0078	0.0303	0.0658	7.2061	2.4258	7.3	6.1
MICR-208-R-2002	7.18	246.6	1047.3	20.383	5.755	9.298	0.0472	0.0058	0.0294	0.0622	6.2186	2.5835	7.9	6.2
MICR-215-R-2002	7.38	172.0	769.2	17.990	2.094	5.382	0.1317	0.0091	0.0542	0.1107	2.4887	5.4033	6.8	16.2
MICR-216-R-2002	7.36	259.0	1256.0	21.642	4.371	10.777	0.0950	0.0065	0.0364	0.0713	4.5711	4.7107	6.6	5.7

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
MICR-106-R-2002	10	5	PA	PA	11	12	7	14	75	0	0	80	92	17	87
MICR-110-R-2002	20	50	CP	FR	16	12	4	7	75	0	0	100	75	16	40
MICR-113-R-2002	50	20	FR	CP	7	7	4	7	59	9	16	100	95	17	27
MICR-118-R-2002	50	45	FR	CP	7	5	8	6	50	7	25	55	95	19	18
MICR-202-R-2002	50	50	TG	FR	10	13	9	13	65	11	10	45	90	15	74
MICR-205-R-2002	50	50	FR	FR	12	13	12	12	63	12	12	100	89	19	54
MICR-207-R-2002	50	40	FR	CP	NS	NS	NS	NS	NS	NS	NS	NS	NS	19	NS
MICR-208-R-2002	50	50	FR	FR	15	13	12	15	65	14	10	25	95	15	81
MICR-215-R-2002	15	50	CP	OF	14	14	7	15	75	0	0	100	20	20	80
MICR-216-R-2002	50	50	FR	FR	16	16	9	9	64	14	11	100	85	19	27

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
MICR-106-R-2002	Y	N	N	N	Moderate	Moderate	None
MICR-110-R-2002	N	N	N	N	None	None	Mild
MICR-113-R-2002	N	N	N	N	Mild	Mild	Moderate
MICR-118-R-2002	N	N	N	N	Moderate	Moderate	Moderate
MICR-202-R-2002	N	N	N	N	Mild	Mild	Moderate
MICR-205-R-2002	N	N	N	N	Moderate	Moderate	Mild
MICR-207-R-2002	N	N	N	N	NS	NS	NS
MICR-208-R-2002	N	N	N	N	Moderate	Mild	Mild
MICR-215-R-2002	N	N	N	N	None	None	None
MICR-216-R-2002	N	N	N	N	None	None	None

Middle Chester River

Fish Species Present

AMERICAN EEL
BLUEGILL
BLUESPOTTED SUNFISH
BROWN BULLHEAD
COMMON CARP
CREEK CHUBSUCKER
EASTERN MUDMINNOW
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MOSQUITOFISH
PUMPKINSEED
REDBREAST SUNFISH
REDFIN PICKEREL
TADPOLE MADTOM
TESSELLATED DARTER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
PHRAGMITES

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
ACILIUS
ANCYRONYX
ARGIA
BATRACOBDELLA
BELOSTOMA
BEZZIA
BRILLIA
CAECIDOTEA
CAENIS
CALOPTERYX
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIRONOMINI
CLINOTANYPUS
COENAGRIONIDAE
CONCHAPELOPIA
CORIXIDAE
CORYNONEURA
CRICOTOPUS
CRYPTOCHIRONOMUS
DICROTENDIPES
DINEUTUS
DUBIRAPHIA
DUGESIA
DYTISCIDAE
ENCHYTRAEIDAE
ENOCHRUS
ERYTHEMIS
FERRISSIA
GAMMARUS
GLOSSIPHONIIDAE
GYRINUS
HEMERODROMIA
HEPTAGENIIDAE
HETEROTRISSOCLADIUS
HYALELLA
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISCHNURA
ISOTOMURUS
KIEFFERULUS
LABRUNDINIA
LIMNODRILUS
LYMNAEIDAE
LYPE
MACRONYCHUS
MENETUS
MEROPELOPIA
MICROCYLLOEPUS
MICROPSECTRA
MICROTENDIPES
MUSCULIUM
NAIDIDAE
NANOCLADIUS
NEOPHYLAX
OECETIS
ORTHOCLADIINAE
ORTHOCLADIUS
PARALAUTERBORNIELLA
PARAMETRIOCNEMUS
PARATANYTARSUS
PARATENDIPES
PELTODYTES
PERICOMA
PHAENOPSECTRA
PHYSELLA
PISIDIUM
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PROSIMULIUM
PROSTOMA
PSEUDOLIMNOPHILA
PSEUDORTHOCLADIUS
PTILOSTOMIS
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIALIS
SIMULIUM
SPHAERIIDAE
SPHAERIUM
SPHAEROMIAS
SPIROSPERMA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENONEMA
STICTOCHIRONOMUS
SYMPOSIOCLADIUS
TABANUS
TANYPODINAE
TANYPUS
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TRIBELOS
TROPISTERNUS
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

Herpetofauna Present

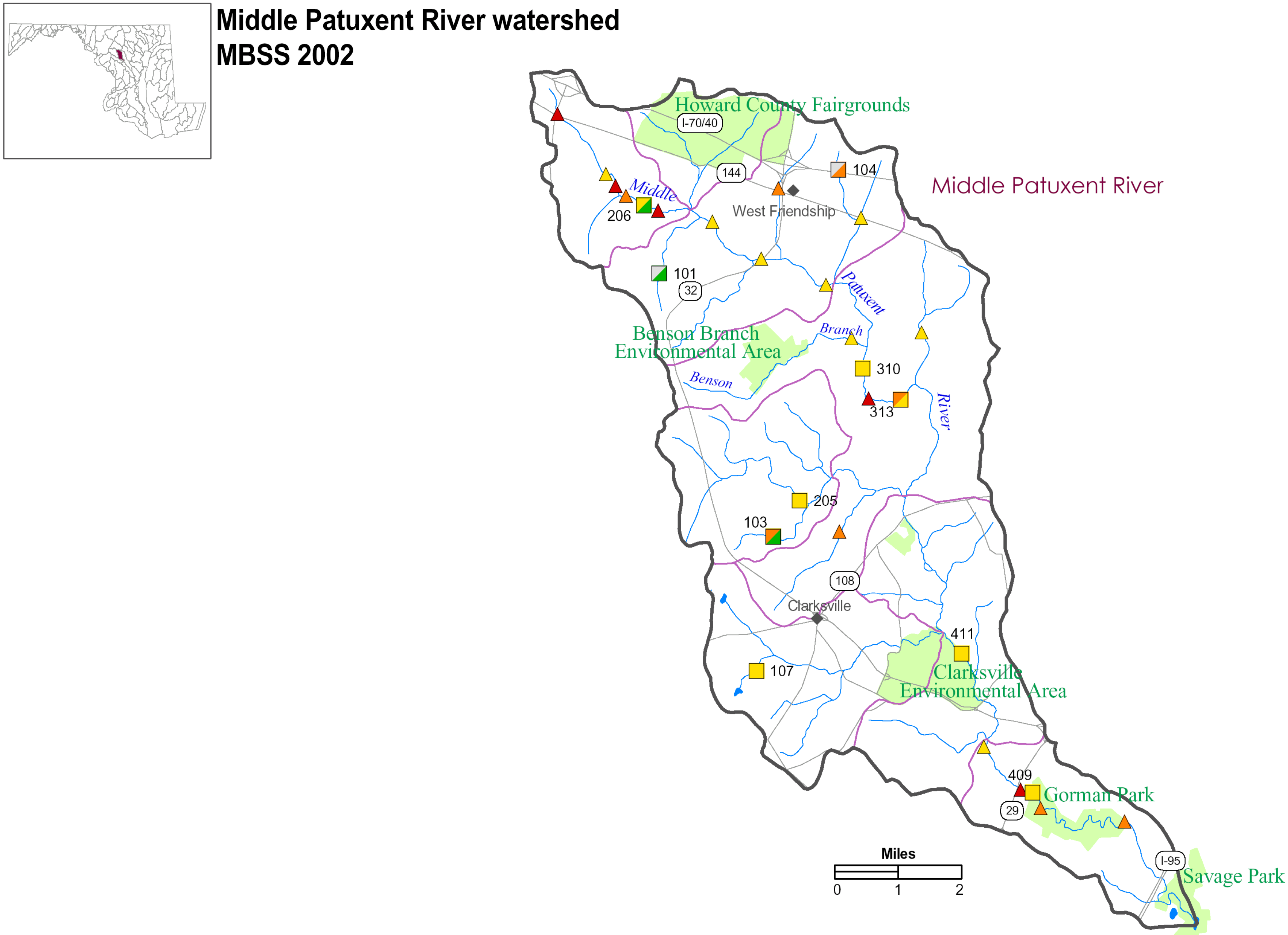
BULLFROG
COMMON MUSK TURTLE
COMMON SNAPPING TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
SOUTHERN LEOPARD FROG

Middle Chester River

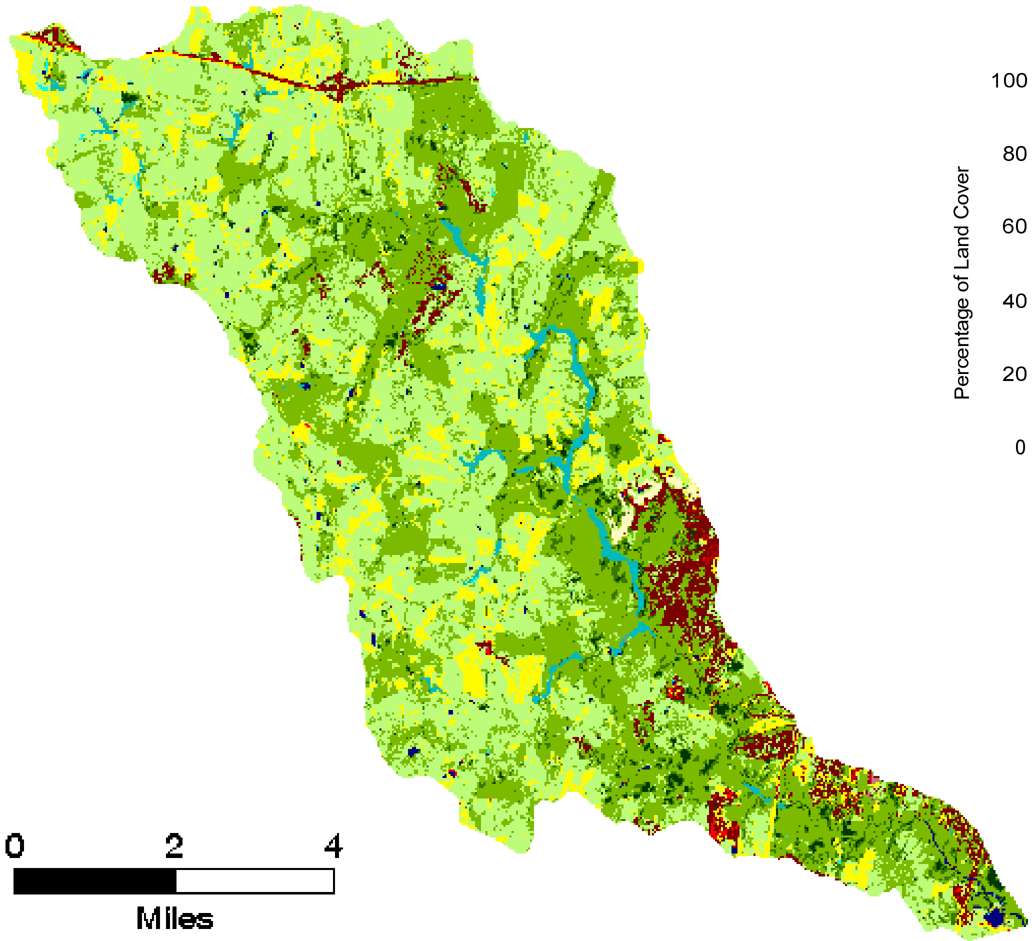
Stream Waders Data

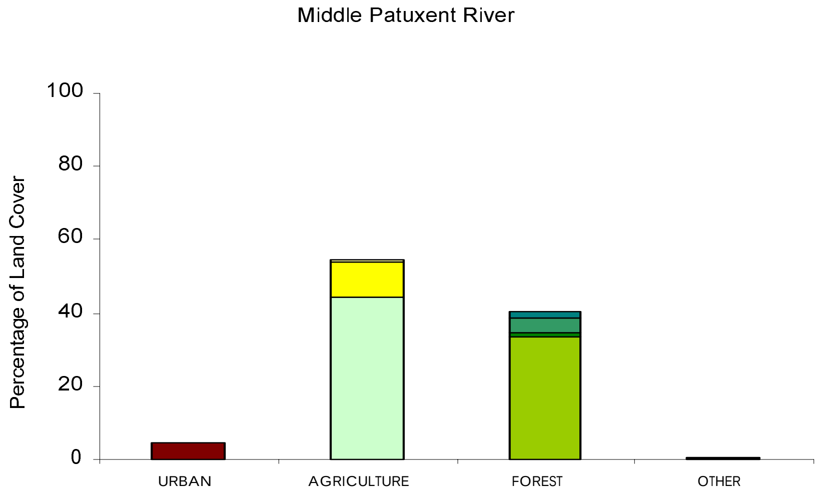
Site	8-Digit Watershed	Stream Name	Benthic IBI
412-3	Middle Chester River	Hambleton Creek	1.57
410-1	Middle Chester River	Chester River UT	1.86
410-2	Middle Chester River	Chester River UT	2.43
411-1	Middle Chester River	Radcliffe Creek	2.14
411-2	Middle Chester River	Radcliffe Creek UT	1.57
412-1	Middle Chester River	Rosin Creek	1.57
412-2	Middle Chester River	Rosin Creek	1.57
414-1	Middle Chester River	Morgan Creek UT	1.57
414-2	Middle Chester River	Morgan Creek UT	1.57
415-1	Middle Chester River	Urieville Lake UT	1.86
415-10	Middle Chester River	Urieville Lake UT	2.43
415-11	Middle Chester River	Urieville Lake UT	1.29
415-2	Middle Chester River	Morgan Creek	1.57
415-3	Middle Chester River	Urieville Lake UT	1.29
415-4	Middle Chester River	Morgan Creek	1.57
415-5	Middle Chester River	Morgan Creek	2.43
415-6	Middle Chester River	Urieville Lake UT	2.14
415-7	Middle Chester River	Urieville Lake UT	2.14
415-8	Middle Chester River	Urieville Lake UT	1.86
415-9	Middle Chester River	Urieville Lake UT	1.57

Middle Patuxent River watershed
MBSS 2002



Middle Patuxent River





Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
MPAX-101-R-	Middle Patuxent R Ut 5	021311060963	Middle Patuxent River	Patuxent River	Howard	21-Mar-02	6-Jun-02	1	232
MPAX-103-R-	Middle Patuxent R Ut	021311060962	Middle Patuxent River	Patuxent River	Howard	21-Mar-02	25-Jun-02	1	427
MPAX-104-R-	Middle Patuxent R Ut 6	021311060963	Middle Patuxent River	Patuxent River	Howard	21-Mar-02	6-Jun-02	1	82
MPAX-107-R-	Middle Patuxent R Ut 4	021311060960	Middle Patuxent River	Patuxent River	Howard	3-Apr-02	25-Jun-02	1	320
MPAX-205-R-	Middle Patuxent R Ut 2	021311060962	Middle Patuxent River	Patuxent River	Howard	21-Mar-02	25-Jun-02	2	1919
MPAX-206-R-	Middle Patuxent R	021311060964	Middle Patuxent River	Patuxent River	Howard	3-Apr-02	6-Jun-02	2	2326
MPAX-310-R-	Middle Patuxent R	021311060961	Middle Patuxent River	Patuxent River	Howard	21-Mar-02	15-Jul-02	3	13533
MPAX-313-R-	Middle Patuxent R	021311060961	Middle Patuxent River	Patuxent River	Howard	4-Apr-02	15-Jul-02	3	14298
MPAX-409-R-	Middle Patuxent R	021311060958	Middle Patuxent River	Patuxent River	Howard	3-Apr-02	31-Jul-02	4	34579
MPAX-411-R-	Middle Patuxent R	021311060959	Middle Patuxent River	Patuxent River	Howard	3-Apr-02	16-Jul-02	4	30833

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
MPAX-101-R-2002	NR	4.11	35.44	0	0
MPAX-103-R-2002	2.11	4.11	48.82	0	0
MPAX-104-R-2002	NR	2.78	1.80	0	0
MPAX-107-R-2002	3.00	3.44	36.38	0	0
MPAX-205-R-2002	3.89	3.44	69.26	0	0
MPAX-206-R-2002	3.67	4.11	64.27	0	0
MPAX-310-R-2002	3.67	3.67	73.04	0	0
MPAX-313-R-2002	2.78	3.44	97.11	0	0
MPAX-409-R-2002	3.67	3.22	66.13	0	0
MPAX-411-R-2002	3.89	3.22	95.87	0	0

Catchment Land Use

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
MPAX-101-R-2002	0.87	87.60	10.48	1.06	0.50
MPAX-103-R-2002	1.41	69.19	29.35	0.05	1.06
MPAX-104-R-2002	13.21	73.05	13.75	0.00	3.84
MPAX-107-R-2002	0.00	59.00	38.71	2.29	0.00
MPAX-205-R-2002	1.11	64.12	34.20	0.57	0.45
MPAX-206-R-2002	3.46	77.37	17.98	1.19	2.59
MPAX-310-R-2002	4.00	62.40	33.02	0.58	2.10
MPAX-313-R-2002	3.79	63.09	32.56	0.57	1.99
MPAX-409-R-2002	4.79	55.99	38.78	0.45	1.91
MPAX-411-R-2002	3.16	59.49	36.89	0.47	1.36

Interpretation of Watershed Condition

- Two sites with high agricultural land use
- Chloride, nitrogen, and phosphorus elevated throughout
- Physical habitat parameters generally good; two sites with no riparian buffer
- Erosion problematic at some sites

Middle Patuxent River

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
MPAX-101-R-2002	7.17	172.8	662.5	15.605	2.019	11.628	0.0355	0.0050	0.0096	0.0665	2.1701	3.6520	6.9	4.8
MPAX-103-R-2002	6.82	134.9	219.0	22.672	2.650	3.096	0.0082	0.0035	0.0029	0.0058	2.7667	1.5123	7	1.4
MPAX-104-R-2002	7.04	2003.0	1694.2	538.200	1.194	14.921	0.0849	0.0105	0.0184	0.0857	1.4951	2.6272	7.3	4.3
MPAX-107-R-2002	7.47	186.6	554.7	24.444	1.790	8.709	0.0191	0.0051	0.0072	0.0072	1.8792	1.6688	6.9	2.8
MPAX-205-R-2002	7.58	290.7	889.9	41.376	1.652	13.501	0.0281	0.0031	0.0110	0.0360	1.8319	3.6571	5.9	1.4
MPAX-206-R-2002	7.07	224.7	355.4	39.009	3.596	4.837	0.0191	0.0040	0.0109	0.0173	3.5928	1.8467	8	3.9
MPAX-310-R-2002	7.52	266.1	624.0	43.782	1.857	11.043	0.0388	0.0049	0.0106	0.0752	2.0900	4.0764	8.4	1.6
MPAX-313-R-2002	7.69	265.7	879.1	36.867	2.573	7.183	0.0178	0.0032	0.0092	0.0570	2.7130	1.7632	7.2	1.5
MPAX-409-R-2002	7.68	272.8	1052.6	34.537	1.920	8.865	0.0126	0.0007	0.0089	0.0068	2.0282	1.9264	4.6	2.9
MPAX-411-R-2002	8.20	260.0	1050.3	30.951	2.054	8.676	0.0139	0.0007	0.0115	0.0071	2.1963	1.9441	8	1.4

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
MPAX-101-R-2002	25	49	PV	HO	12	14	11	11	39	11	36	30	85	15	47
MPAX-103-R-2002	50	50	TG	FR	14	14	12	13	50	12	26	25	88	15	72
MPAX-104-R-2002	50	50	OF	LN	1	1	2	2	57	6	18	50	95	13	9
MPAX-107-R-2002	0	0	PA	PA	11	13	11	11	60	11	16	20	70	16	52
MPAX-205-R-2002	50	0	OF	PA	15	14	14	15	56	15	21	15	80	15	61
MPAX-206-R-2002	20	50	PA	LN	13	14	13	12	63	15	12	60	80	14	51
MPAX-310-R-2002	28	50	CP	TG	14	12	13	14	64	15	11	40	60	15	77
MPAX-313-R-2002	50	50	FR	FR	15	15	13	16	60	15	15	25	90	15	99
MPAX-409-R-2002	50	50	FR	FR	16	12	12	14	75	12	21	80	85	7	115
MPAX-411-R-2002	50	50	FR	FR	17	19	17	16	48	17	52	25	76	9	70

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
MPAX-101-R-2002	Y	N	N	Y	Moderate	Severe	Mild
MPAX-103-R-2002	N	N	N	N	Severe	Severe	Severe
MPAX-104-R-2002	Y	N	N	Y	None	None	Mild
MPAX-107-R-2002	Y	N	N	N	Moderate	Mild	Mild
MPAX-205-R-2002	Y	N	N	N	Mild	Moderate	Moderate
MPAX-206-R-2002	N	N	N	N	Moderate	Moderate	Mild
MPAX-310-R-2002	N	N	N	N	Moderate	Mild	Mild
MPAX-313-R-2002	N	N	N	N	Severe	Mild	Mild
MPAX-409-R-2002	Y	N	N	N	Severe	Severe	Moderate
MPAX-411-R-2002	N	N	N	N	Mild	Moderate	Moderate

Middle Patuxent River

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BROWN BULLHEAD
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
FALLFISH
GREEN SUNFISH
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
PUMPKINSEED
REDBREAST SUNFISH
RIVER CHUB
ROCK BASS
ROSYFACE SHINER
ROSYSIDE DACE
SATINFIN SHINER
SHIELD DARTER
SMALLMOUTH BASS
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER

Exotic Plants Present

BAMBOO
JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACRONEURIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANCYRONYX
ANTOCHA
ARGIA
BAETIDAE
BEZZIA
BOYERIA
BRILLIA
BRUNDINIELLA
CALOPTERYX
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMIDAE
CHIRONOMINAE
CHIRONOMINI
CLADOTANYTARSUS
COENAGRIONIDAE
CONCHAPELOPIA
CORBICULA
CORIXIDAE
CORYDALUS
CORYNONEURA
CRANGONYCTIDAE
CRICOTOPUS
CRYPTOCHIRONOMUS
CURCULIONIDAE
DIAMESA
DINEUTUS
DIPLECTRONA
DIPLOPERLA
DIPTERA
DIXELLA
DUBIRAPHIA
DUGESIA
EMPIDIDAE
ENDOCHIRONOMUS
EPHEMERELLA
ERIOPTERA
EUKIEFFERIELLA
EURYLOPHELLA
HELICHUS
HEMERODROMIA
HEPTAGENIIDAE
HETEROTRISSOCLADIUS
HYDROBAENUS
HYDROBIUS
HYDROPORUS
HYDROPSYCHE
HYDROPSYCHIDAE
HYDROPTILA
ISONYCHIA
LABRUNDINIA
LEPIDOPTERA
LEPTOPHLEBIIDAE
LIMNEPHILIDAE
LIMNODRILUS
LUMBRICULIDAE
LYPE
MACRONYCHUS
MEROPELOPIA
MICRASEMA
MICROPSECTRA
MICROTENDIPES
MOLANNA
NAIDIDAE
NANOCLADIUS
NATARSIA
NEMOURIDAE
NEOPHYLAX
NIGRONIA
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARACHAETOCLADIUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PARATENDIPES
PERLIDAE
PERLODIDAE
PHAENOPSECTRA
POLYCENTROPODIDAE
POLYCENTROPUS
POLYPEDILUM
PRODIAMESA
PROSIMULIUM
PROSTOMA
PSEUDOLIMNOPHILA
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIALIS
SIMULIIDAE
SIMULIUM
SPHAERIIDAE
SPHAERIUM
SPIROSPERMA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENOCHIRONOMUS
STENONEMA
STYLOGOMPHUS
SYMPOSIOCLADIUS
SYMPOTTHASTIA
SYNORTHOCLADIUS
SYRPHIDAE
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TRIBELOS
TRISSOPELOPIA
TVETENIA
ZAVRELIMYIA

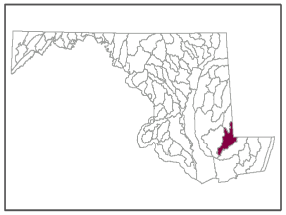
Herpetofauna Present

AMERICAN TOAD
BLACK RAT SNAKE
BULLFROG
COMMON SNAPPING TURTLE
FOWLER'S TOAD
GREEN FROG
NORTHERN RINGNECK SNAKE
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG

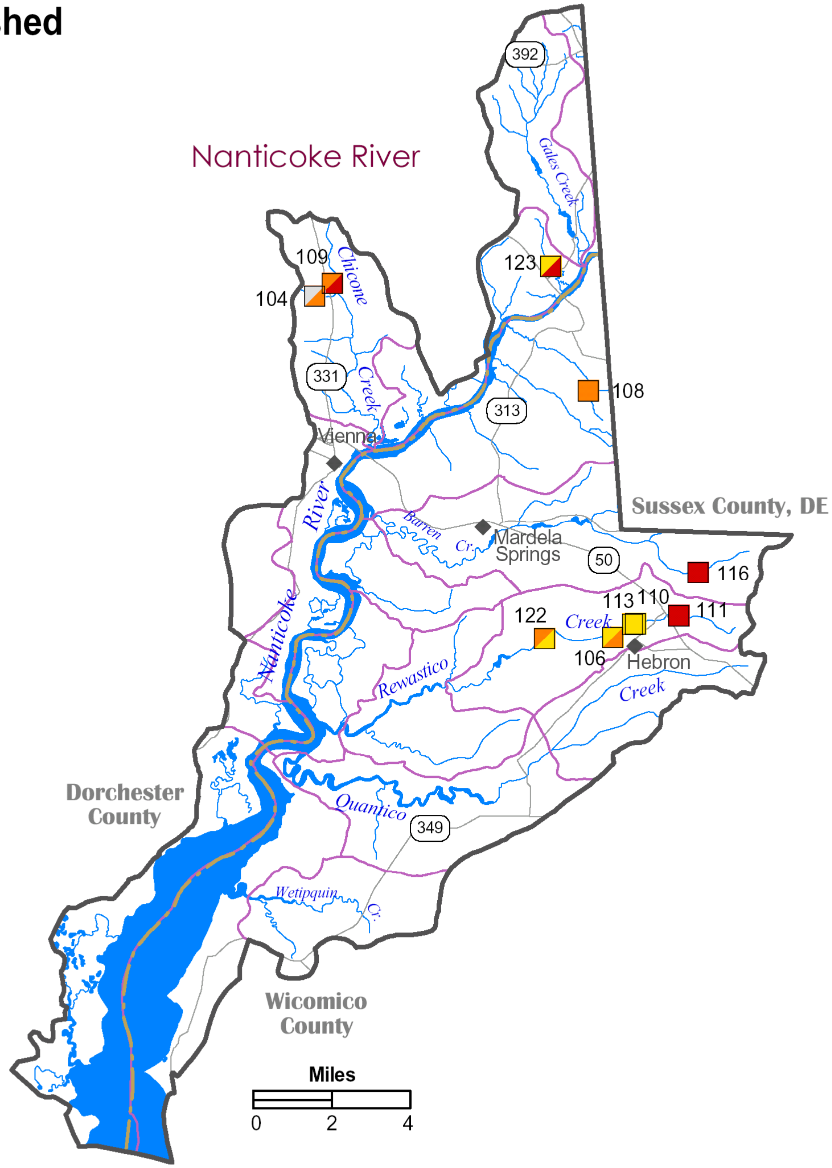
Middle Patuxent River

Stream Waders Data

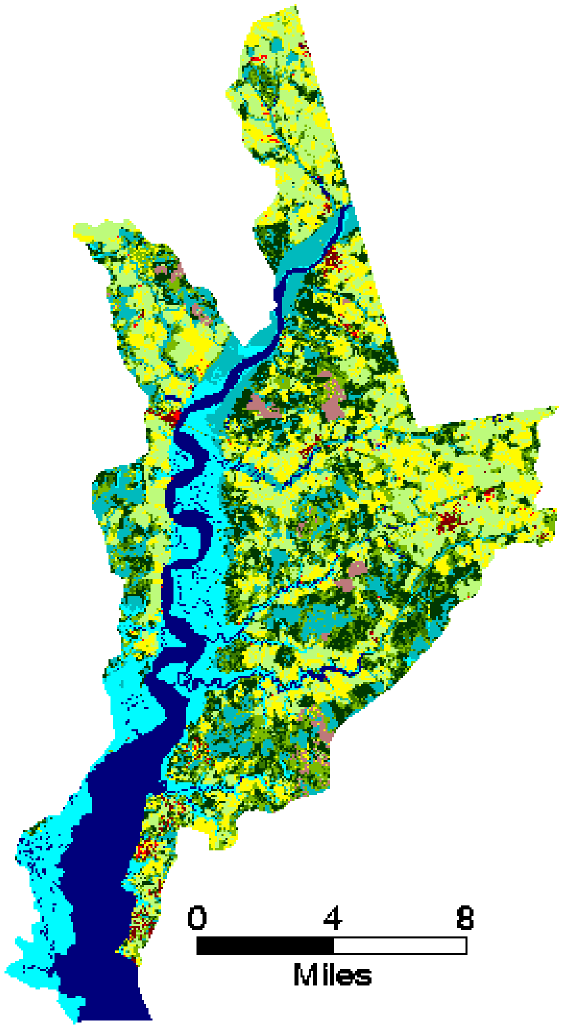
Site	8-Digit Watershed	Stream Name	Benthic IBI
964-5	Middle Patuxent River	Middle Patuxent River	1.29
958-1	Middle Patuxent River	Middle Patuxent River	1.29
958-2	Middle Patuxent River	Middle Patuxent River	2.14
958-3	Middle Patuxent River	Middle Patuxent River	2.14
958-4	Middle Patuxent River	Middle Patuxent River	3.29
961-1	Middle Patuxent River	Middle Patuxent River UT	2.14
961-2	Middle Patuxent River	Middle Patuxent River	1.00
961-3	Middle Patuxent River	Middle Patuxent River UT	3.86
961-4	Middle Patuxent River	Benson Branch	3.29
961-5	Middle Patuxent River	Benson Branch	
963-1	Middle Patuxent River	Middle Patuxent River	3.57
963-2	Middle Patuxent River	Middle Patuxent River UT	2.71
963-3	Middle Patuxent River	Middle Patuxent River	3.00
963-4	Middle Patuxent River	Middle Patuxent River UT	3.29
963-5	Middle Patuxent River	Middle Patuxent River	3.00
964-1	Middle Patuxent River	Middle Patuxent River UT	1.57
964-2	Middle Patuxent River	Middle Patuxent River	3.00
964-3	Middle Patuxent River	Middle Patuxent River	2.71
964-4	Middle Patuxent River	Middle Patuxent River	1.57

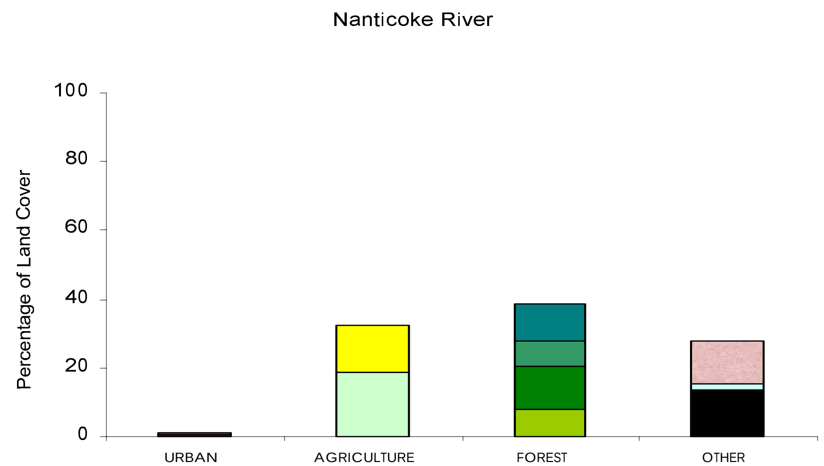


Nanticoke River watershed
MBSS 2002



Nanticoke River





Nanticoke River

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
NANT-104-R-2002	Chicone Cr Ut	021303050586	Nanticoke River	Nanticoke River	Dorchester	13-Mar-02	6-Jun-02	1	96
NANT-106-R-2002	Rewastico Cr	021303050581	Nanticoke River	Nanticoke River	Wicomico	12-Mar-02	18-Jun-02	1	2788
NANT-108-R-2002	Plum Cr Ut	021303050584	Nanticoke River	Nanticoke River	Wicomico	13-Mar-02	5-Jun-02	1	344
NANT-109-R-2002	Chicone Cr	021303050586	Nanticoke River	Nanticoke River	Dorchester	13-Mar-02	6-Jun-02	1	1782
NANT-110-R-2002	Rewastico Cr	021303050581	Nanticoke River	Nanticoke River	Wicomico	14-Mar-02	17-Jun-02	1	2257
NANT-111-R-2002	Rewastico Cr	021303050581	Nanticoke River	Nanticoke River	Wicomico	13-Mar-02	17-Jun-02	1	1152
NANT-113-R-2002	Rewastico Cr	021303050581	Nanticoke River	Nanticoke River	Wicomico	14-Mar-02	17-Jun-02	1	2300
NANT-116-R-2002	Barren Cr	021303050583	Nanticoke River	Nanticoke River	Wicomico	13-Mar-02	5-Jun-02	1	1286
NANT-122-R-2002	Rewastico Cr	021303050581	Nanticoke River	Nanticoke River	Wicomico	13-Mar-02	17-Jun-02	1	4755
NANT-123-R-2002	Dennis Cr	021303050587	Nanticoke River	Nanticoke River	Dorchester	13-Mar-02	5-Jun-02	1	668

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
NANT-104-R-2002	NS	2.14	NS	NS	NS
NANT-106-R-2002	3.00	2.71	49.64	0	0
NANT-108-R-2002	2.00	2.14	7.41	0	0
NANT-109-R-2002	2.50	1.29	22.50	0	0
NANT-110-R-2002	3.25	3.00	15.17	0	0
NANT-111-R-2002	1.50	1.86	2.62	0	0
NANT-113-R-2002	3.00	2.43	15.17	0	0
NANT-116-R-2002	1.75	1.57	7.26	0	0
NANT-122-R-2002	2.75	3.29	96.05	0	0
NANT-123-R-2002	3.00	1.00	62.84	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
NANT-104-R-2002	0.00	59.63	40.37	0.00	0.00
NANT-106-R-2002	6.18	73.78	19.58	0.45	2.59
NANT-108-R-2002	0.06	67.20	32.73	0.00	0.02
NANT-109-R-2002	0.07	50.54	47.42	1.97	0.06
NANT-110-R-2002	4.53	74.89	20.03	0.54	2.23
NANT-111-R-2002	3.75	74.69	21.53	0.04	1.96
NANT-113-R-2002	5.10	74.43	19.94	0.53	2.38
NANT-116-R-2002	0.09	68.51	31.41	0.00	0.05
NANT-122-R-2002	3.81	69.93	24.90	1.36	1.65
NANT-123-R-2002	0.00	79.65	20.25	0.10	0.00

Interpretation of Watershed Condition

- One site with high agricultural land use
- Nitrogen and phosphorus elevated throughout
- High DOC at some sites indicative of natural, swampy conditions

Nanticoke River

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
NANT-104-R-2002	6.38	239.1	559.7	27.379	0.030	31.267	0.1915	0.0131	0.0053	0.0212	0.9846	17.2848	NS	NS
NANT-106-R-2002	6.57	192.4	324.8	18.771	6.945	12.948	0.0126	0.0030	0.0099	0.0216	7.0650	1.3808	6.8	2.1
NANT-108-R-2002	6.24	117.2	361.4	10.230	0.155	14.373	0.0308	0.0007	0.0057	0.1247	0.5121	9.5321	5.1	4.8
NANT-109-R-2002	5.21	112.2	0.8	15.248	0.771	19.192	0.0429	0.0007	0.0053	0.0647	0.8974	4.0118	6.3	5.6
NANT-110-R-2002	6.68	189.6	332.7	19.680	6.873	10.798	0.0120	0.0026	0.0110	0.0224	6.9458	1.4919	8.3	2.3
NANT-111-R-2002	7.41	211.9	1671.4	8.048	0.164	8.269	0.0231	0.0134	0.0067	0.0100	0.5854	8.3681	4.8	6.3
NANT-113-R-2002	6.68	187.1	336.0	19.149	7.068	10.818	0.0121	0.0041	0.0101	0.0233	7.0771	1.5205	8.3	2.3
NANT-116-R-2002	6.90	120.1	727.9	11.803	0.033	0.749	0.1276	0.0106	0.0052	0.0696	0.8492	14.1925	4.1	5
NANT-122-R-2002	6.90	162.0	354.9	14.633	5.283	12.424	0.0160	0.0007	0.0133	0.0264	5.5409	2.4892	8.8	1.6
NANT-123-R-2002	5.06	211.8	8.2	15.399	12.019	20.999	0.0061	0.0007	0.0022	0.0054	12.1881	0.8737	5.6	8.9

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
NANT-104-R-2002	50	0	FR	CP	NS	NS	NS	NS	NS	NS	NS	NS	NS	18	NS
NANT-106-R-2002	50	50	FR	FR	17	10	8	13	65	11	10	100	92	5	54
NANT-108-R-2002	50	35	FR	CP	5	2	2	6	25	0	0	100	95	13	36
NANT-109-R-2002	50	50	LN	FR	13	7	4	8	75	0	0	100	90	12	38
NANT-110-R-2002	50	50	FR	FR	6	5	5	8	70	11	10	100	85	18	24
NANT-111-R-2002	10	50	PK	FR	3	1	3	3	71	3	4	85	92	1	22
NANT-113-R-2002	50	42	FR	CP	6	5	5	8	75	0	0	100	95	16	34
NANT-116-R-2002	50	50	FR	FR	2	2	2	6	70	6	10	94	92	19	28
NANT-122-R-2002	50	25	FR	CP	18	16	15	17	35	16	45	25	90	17	90
NANT-123-R-2002	15	12	CP	CP	13	10	8	13	65	8	10	70	97	15	63

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
NANT-104-R-2002	Y	N	N	Y	NS	NS	NS
NANT-106-R-2002	N	N	N	N	None	None	Mild
NANT-108-R-2002	Y	N	N	Y	None	None	None
NANT-109-R-2002	N	N	N	Y	Mild	None	Mild
NANT-110-R-2002	N	N	N	Y	None	None	Severe
NANT-111-R-2002	N	N	N	Y	None	None	None
NANT-113-R-2002	N	N	N	Y	None	Mild	Severe
NANT-116-R-2002	N	N	N	Y	None	None	Mild
NANT-122-R-2002	N	N	N	N	None	None	Mild
NANT-123-R-2002	Y	N	N	Y	None	None	Mild

Nanticoke River
Fish Species Present

AMERICAN EEL
BLUEGILL
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUBSUCKER
EASTERN MUDMINNOW
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MOSQUITOFISH
MUD SUNFISH
PIRATE PERCH
PUMPKINSEED
REDFIN PICKEREL
TADPOLE MADTOM

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
PHRAGMITES

Benthic Taxa Present

ABLABESMYIA
AGABUS
AMPHIPODA
ANCYRONYX
APSECTROTANYPUS
BOYERIA
BRILLIA
CAECIDOTEA
CALOPTERYX
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINI
CHIRONOMUS
CONCHAPELOPIA
CORDULEGASTER
CORIXIDAE
CORYNONEURA
CRANGONYCTIDAE
CRANGONYX
CRICOTOPUS
CULICOIDES
CURA
DICROTENDIPES
DINEUTUS
DIPLOCLADIUS
DUGESIA
DYTISCIDAE
ENALLAGMA
ENOCHRUS
FERRISSIA
GAMMARUS
GYRINUS
HEMERODROMIA
HEPTAGENIIDAE
HETEROPLECTRON
HYDROBAENUS
HYDROBIUS
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISCHNURA
ISOTOMURUS
LABRUNDINIA
LEPIDOPTERA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LIBELLULIDAE
LIMNEPHILIDAE
LIMNOPHYES
LUMBRICULIDAE
LYMNAEIDAE
LYPE
MACRONYCHUS
MATUS
MENETUS
MICROCYLLOEPUS
MICROPSECTRA
MICROTENDIPES
MICROVELIA
MUSCIDAE
NAIDIDAE
NANOCLADIUS
NIGRONIA
ORTHOCLADIINAE
ORTHOCLADIUS
PARAMERINA
PARAMETRIOCNEMUS
PARATENDIPES
PELTODYTES
PHAENOPSECTRA
PHAGOCATA
PHYSELLA
PISIDIUM
POLYPEDILUM
POTTHASTIA
PROCLADIUS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
SCIRTIDAE
SIALIS
SIMULIUM
SOMATOCHLORA
SPHAERIIDAE
SPHAERIUM
STEMPELLINELLA
STENONEMA
STYGONECTES
SYNURELLA
TABANIDAE
TANYPODINAE
TANYTARSUS
THIENEMANNIMYIA GROUP
TRIBELOS
TRISSOPELOPIA
TUBIFICIDAE
XYLOTOPUS
ZAVRELIMYIA

Herpetofauna Present

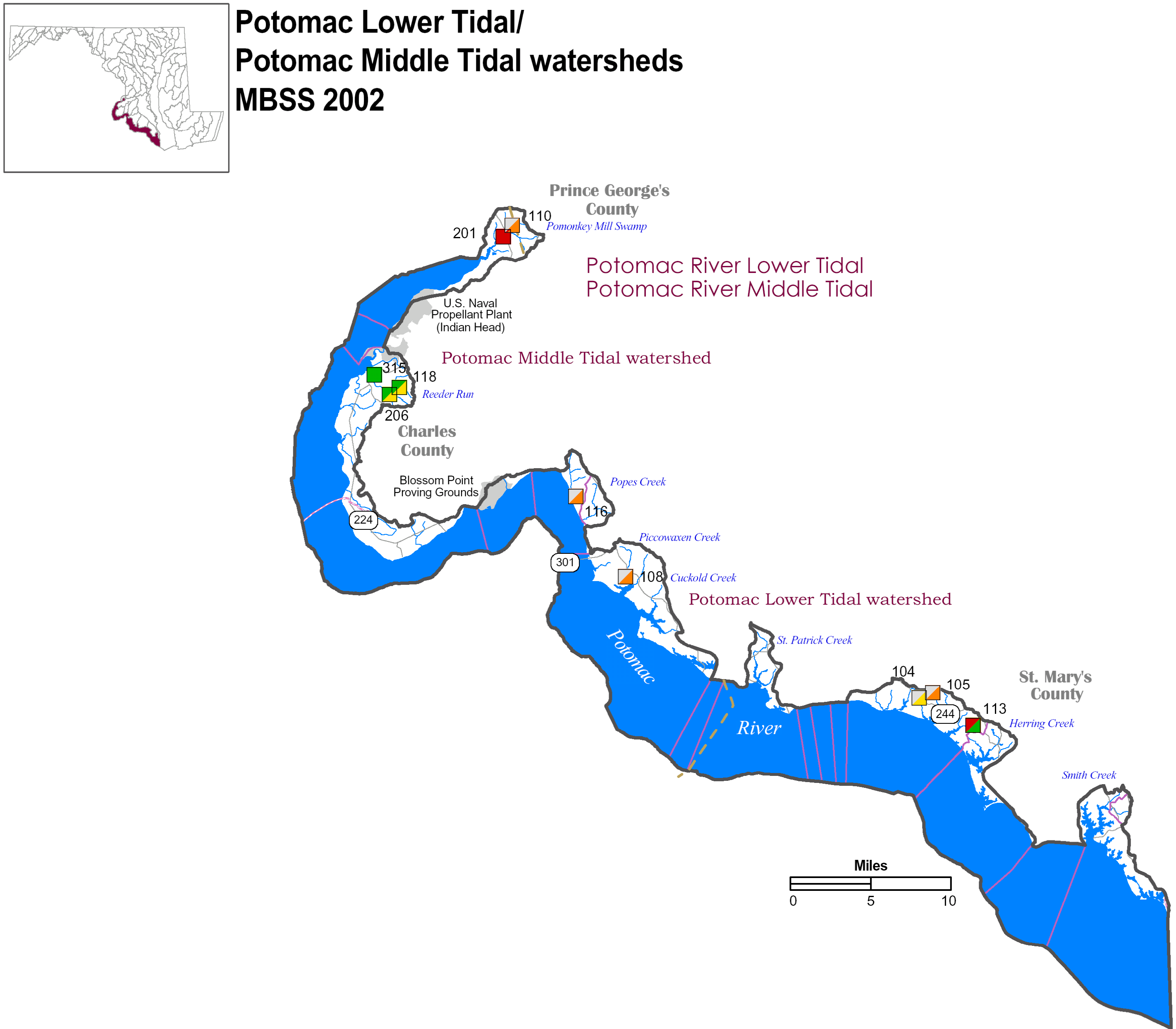
BULLFROG
FOWLER'S TOAD
GREEN FROG
NORTHERN WATER SNAKE
SOUTHERN LEOPARD FROG

Nanticoke River

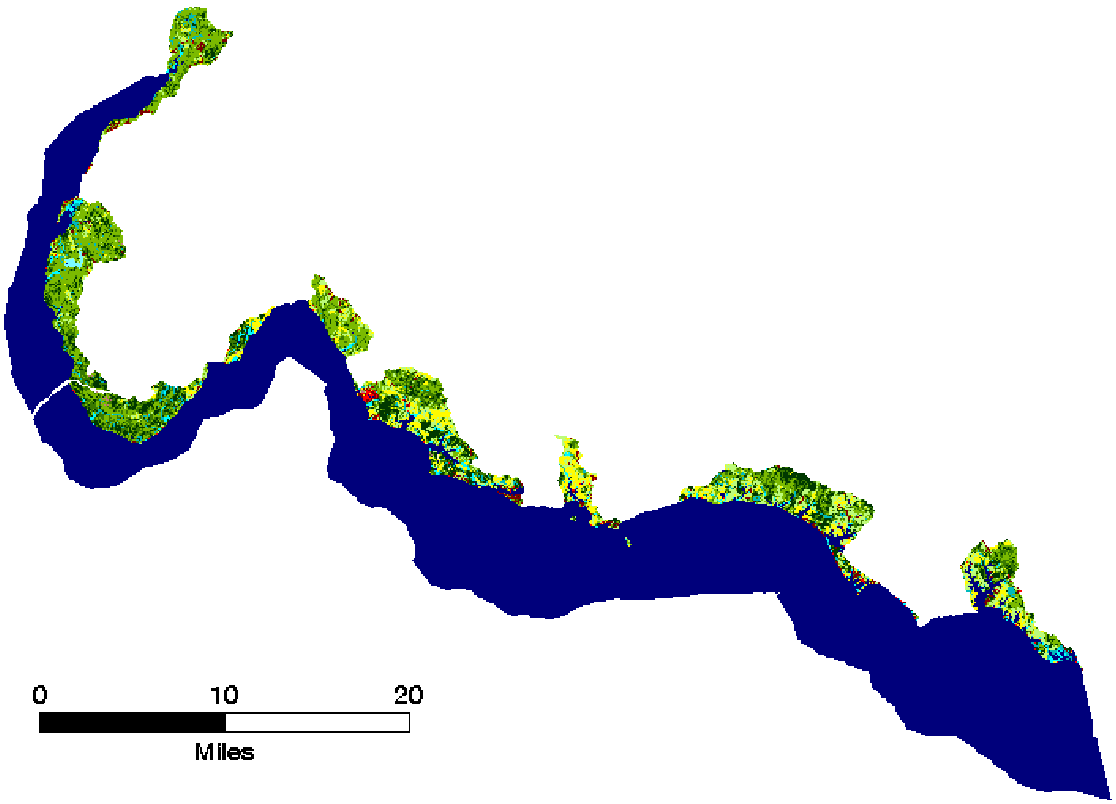
Stream Waders Data

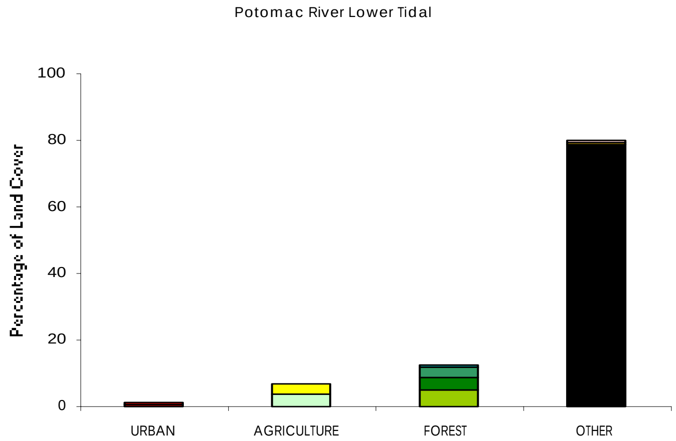
No stream waders data collected in 2002

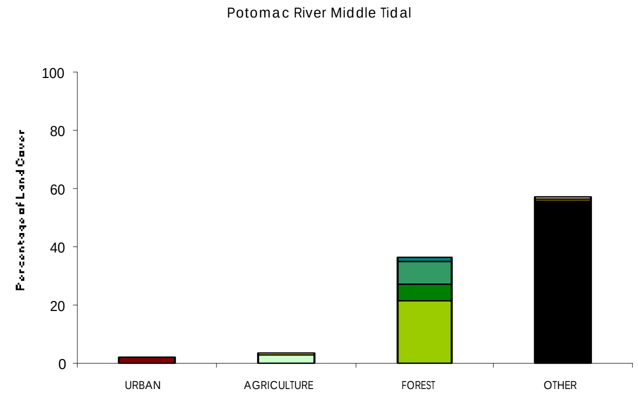
Potomac Lower Tidal/
Potomac Middle Tidal watersheds
MBSS 2002



Potomac River Lower Tidal/Potomac River Middle Tidal







Potomac River Lower Tidal/Potomac River Middle Tidal

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
PRLT-104-R-2002	Belvedere Cr	021401010698	Potomac River (Lower-tidal)	Lower Potomac River	St. Marys	11-Mar-02	25-Jun-02	1	192
PRLT-105-R-2002	Poplar Hill Cr	021401010698	Potomac River (Lower-tidal)	Lower Potomac River	St. Marys	19-Mar-02	25-Jun-02	1	112
PRLT-108-R-2002	Ditchley Pronge	021401010704	Potomac River (Lower-tidal)	Lower Potomac River	Charles	18-Mar-02	3-Jun-02	1	1374
PRLT-113-R-2002	Tarleton Br	021401010698	Potomac River (Lower-tidal)	Lower Potomac River	St. Marys	11-Mar-02	25-Jun-02	1	351
PRLT-116-R-2002	Potomac R Ut	021401010705	Potomac River (Lower-tidal)	Lower Potomac River	Charles	18-Mar-02	3-Jun-02	1	278
PRMT-110-R-2002	Mill Swamp Run Ut 2	021401020791	Potomac River (Middle-tidal)	Lower Potomac River	Charles	19-Mar-02	1-Jul-02	1	217
PRMT-118-R-2002	Reeder Run Ut	021401020789	Potomac River (Middle-tidal)	Lower Potomac River	Charles	14-Mar-02	9-Jul-02	1	544
PRMT-201-R-2002	Mill Swamp Run Ut 1	021401020791	Potomac River (Middle-tidal)	Lower Potomac River	Charles	21-Mar-02	1-Jul-02	2	1884
PRMT-206-R-2002	Reeder Run	021401020789	Potomac River (Middle-tidal)	Lower Potomac River	Charles	14-Mar-02	23-Jul-02	2	729
PRMT-315-R-2002	Reeder Run	021401020789	Potomac River (Middle-tidal)	Lower Potomac River	Charles	19-Mar-02	23-Jul-02	3	3211

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
PRLT-104-R-2002	NR	3.29	19.40	0	0
PRLT-105-R-2002	NR	2.71	10.84	0	0
PRLT-108-R-2002	NS	2.43	NS	NS	NS
PRLT-113-R-2002	1.75	4.43	59.44	0	0
PRLT-116-R-2002	NS	2.14	NS	NS	NS
PRMT-110-R-2002	NS	2.14	NS	NS	NS
PRMT-118-R-2002	4.50	3.00	90.31	0	0
PRMT-201-R-2002	1.50	1.57	4.46	0	0
PRMT-206-R-2002	4.50	3.29	86.88	0	0
PRMT-315-R-2002	4.25	4.14	73.08	0	0

Catchment Land Use Information

Site	Percent	Percent	Percent	Percent	Percent
PRLT-104-R-2002	0.35	1.16	98.49	0.00	0.09
PRLT-105-R-2002	6.55	27.58	64.88	0.99	1.64
PRLT-108-R-2002	4.01	23.45	72.41	0.13	1.21
PRLT-113-R-2002	1.52	49.34	49.15	0.00	0.47
PRLT-116-R-2002	0.08	17.31	82.37	0.24	0.06
PRMT-110-R-2002	0.00	16.29	83.71	0.00	0.00
PRMT-118-R-2002	1.06	4.45	92.16	2.33	0.27
PRMT-201-R-2002	11.30	5.73	82.94	0.04	3.07
PRMT-206-R-2002	2.54	5.44	91.96	0.06	0.66
PRMT-315-R-2002	1.58	6.64	90.51	1.28	0.41

Interpretation of Watershed Condition

- ANC values low at several sites
- Dissolved oxygen and turbidity low at several sites
- Riffle/run quality very poor at several sites
- Erosion severe at some sites

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
PRLT-104-R-2002	5.63	66.0	17.3	12.990	0.001	5.752	0.0089	0.0007	0.0004	0.0047	0.0980	2.8028	6.7	3.8
PRLT-105-R-2002	5.18	47.7	7.0	8.074	0.001	4.446	0.0112	0.0007	0.0005	0.0114	0.0980	2.1380	0.6	24.6
PRLT-108-R-2002	6.56	137.9	278.1	24.804	0.131	7.249	0.1147	0.0053	0.0045	0.1407	0.5101	7.6470	NS	NS
PRLT-113-R-2002	6.16	93.0	69.9	14.536	1.547	7.543	0.0089	0.0007	0.0021	0.0114	1.6039	1.9468	6.9	7.3
PRLT-116-R-2002	6.88	96.6	339.8	7.057	0.048	12.159	0.1326	0.0162	0.0024	0.0410	0.2735	5.0894	NS	NS
PRMT-110-R-2002	5.50	86.0	15.7	5.239	0.001	23.746	0.0119	0.0027	0.0008	0.0047	0.0980	3.7605	NS	NS
PRMT-118-R-2002	6.64	62.1	180.7	8.748	0.055	4.304	0.0062	0.0007	0.0009	0.0273	0.2204	4.1632	4.6	8.6
PRMT-201-R-2002	6.64	147.2	179.7	22.419	0.173	18.113	0.0245	0.0042	0.0026	0.0219	0.3358	4.4159	2.2	20.1
PRMT-206-R-2002	6.81	78.6	358.6	6.133	0.128	6.849	0.0047	0.0007	0.0032	0.0353	0.3022	4.0724	2.6	16.4
PRMT-315-R-2002	7.17	93.2	439.9	6.275	0.085	7.946	0.0223	0.0007	0.0032	0.0585	0.3622	5.7020	1	18.3

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
PRLT-104-R-2002	50	30	FR	HO	10	10	5	8	60	6	15	75	97	10	26
PRLT-105-R-2002	50	50	FR	FR	4	4	2	7	39	0	0	100	90	20	39
PRLT-108-R-2002	20	50	CR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	12	NS
PRLT-113-R-2002	50	50	FR	FR	12	16	5	10	47	5	28	15	97	19	45
PRLT-116-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	17	NS
PRMT-110-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
PRMT-118-R-2002	50	50	FR	FR	15	15	8	17	71	6	4	30	35	19	98
PRMT-201-R-2002	50	50	FR	FR	1	1	0	2	8	0	0	60	88	16	32
PRMT-206-R-2002	50	50	FR	FR	17	15	7	18	75	0	0	100	47	20	112
PRMT-315-R-2002	50	50	FR	FR	14	15	7	14	60	0	0	60	95	17	76

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
PRLT-104-R-2002	N	N	N	N	Moderate	Moderate	Moderate
PRLT-105-R-2002	N	N	N	N	Moderate	Moderate	Mild
PRLT-108-R-2002	N	N	N	N	NS	NS	NS
PRLT-113-R-2002	N	N	N	N	Severe	Severe	Mild
PRLT-116-R-2002	N	N	N	N	NS	NS	NS
PRMT-110-R-2002	N	N	N	N	NS	NS	NS
PRMT-118-R-2002	N	N	N	N	None	None	Mild
PRMT-201-R-2002	N	N	N	N	Moderate	Severe	Severe
PRMT-206-R-2002	N	N	N	N	None	None	Mild
PRMT-315-R-2002	N	N	N	N	Severe	Severe	Severe

Potomac River Lower Tidal/Potomac River Middle Tidal

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BROWN BULLHEAD
CHAIN PICKEREL
CREEK CHUB
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LEAST BROOK LAMPREY
MARGINED MADTOM
MOSQUITOFISH
PUMPKINSEED
REDBREAST SUNFISH
SEA LAMPREY
WARMOUTH
WHITE SUCKER

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
AGABUS
ALLOPERLA
AMPHINEMURA
ANCHYTARSUS
APSECTROTANYPUS
BAETIDAE
CAECIDOTEA
CAENIS
CAMBARIDAE
CENTROPTILUM
CERATOPOGON
CERATOPOGONIDAE
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMUS
CHLOROPERLIDAE
CHRYSOPS
CONCHAPELOPIA
CORBICULA
CORDULEGASTER
CORIXIDAE
CORYNONEURA
CRANGONYX
CRICOTOPUS
DIAMESA
DIPLECTRONA
DIPLOCLADIUS
DIPLOPERLA
DIPTERA
ECCOPTURA
ERIOPTERA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GAMMARUS
GOMPHIDAE
GORDIIDAE
HABROPHLEBIA
HELICHUS
HEMERODROMIA
HEPTAGENIIDAE
HESPEROCORIXA
HETEROTRISSOCLADIUS
HEXATOMA
HYALELLA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISOTOMURUS
LEPIDOPTERA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCTRA
LEUCTRIDAE
LIMNEPHILIDAE
LUMBRICULIDAE
LYPE
MEROPELOPIA
MICROCYLLOEPUS
MICROPSECTRA
MICROTENDIPES
NAIDIDAE
NEMOURIDAE
NIGRONIA
ODONATA
OEMOPTERYX
ORTHOCLADIINAE
ORTHOCLADIUS
OSTROCERCA
OULIMNIUS
PARACAPNIA
PARAKIEFFERIELLA
PARAMETRIOCNEMUS
PERLIDAE
PHAENOPSECTRA
PHILOPOTAMIDAE
PHYSELLA
POLYCENTROPUS
POLYPEDILUM
POTTHASTIA
PROBEZZIA
PROSIMULIUM
PROSTOIA
PROSTOMA
PSEPHENUS
PSEUDOLIMNOPHILA
PTILOSTOMIS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIALIS
SIMULIIDAE
SIMULIUM
SIPHLONURUS
SOMATOCHLORA
SPHAERIIDAE
SPHAERIUM
SPIROSPERMA
STEGOPTERNA
STEMPELLINELLA
STENONEMA
SYNURELLA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
UNNIELLA
ZAVRELIMYIA

Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON MUSK TURTLE
EASTERN BOX TURTLE
EASTERN GARTER SNAKE
FIVE-LINED SKINK
FOWLER’S TOAD
GRAY TREEFROG
GREEN FROG
NORTHERN CRICKET FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
PSEUDOTRITON SP.
RED SPOTTED NEWT
SOUTHERN LEOPARD FROG
WOOD FROG

Potomac River Lower Tidal/Potomac River Middle Tidal

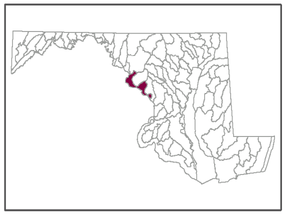
Stream Waders Data

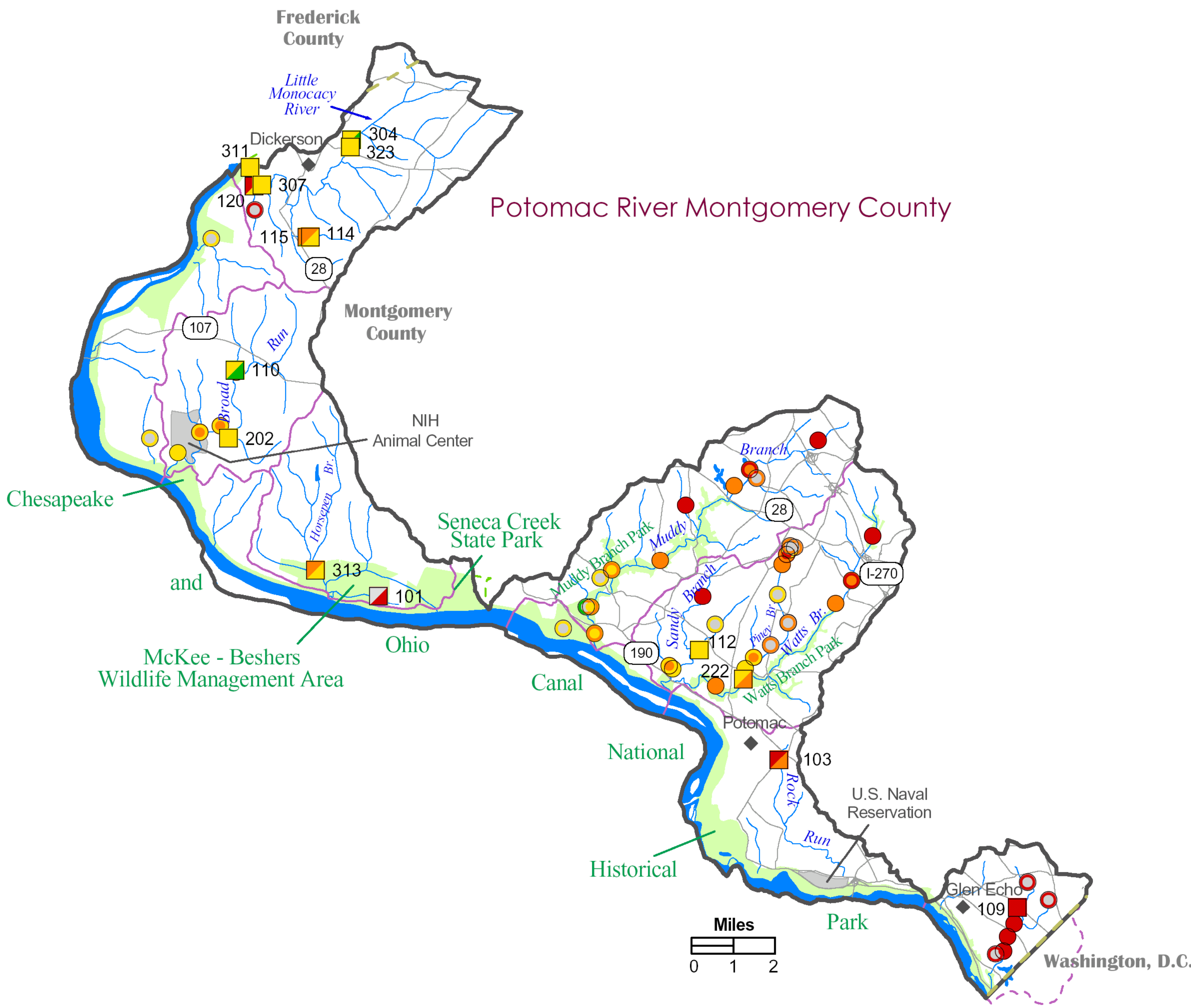
No Stream Waders data collected in 2002

Potomac River Lower Tidal/Potomac River Middle Tidal

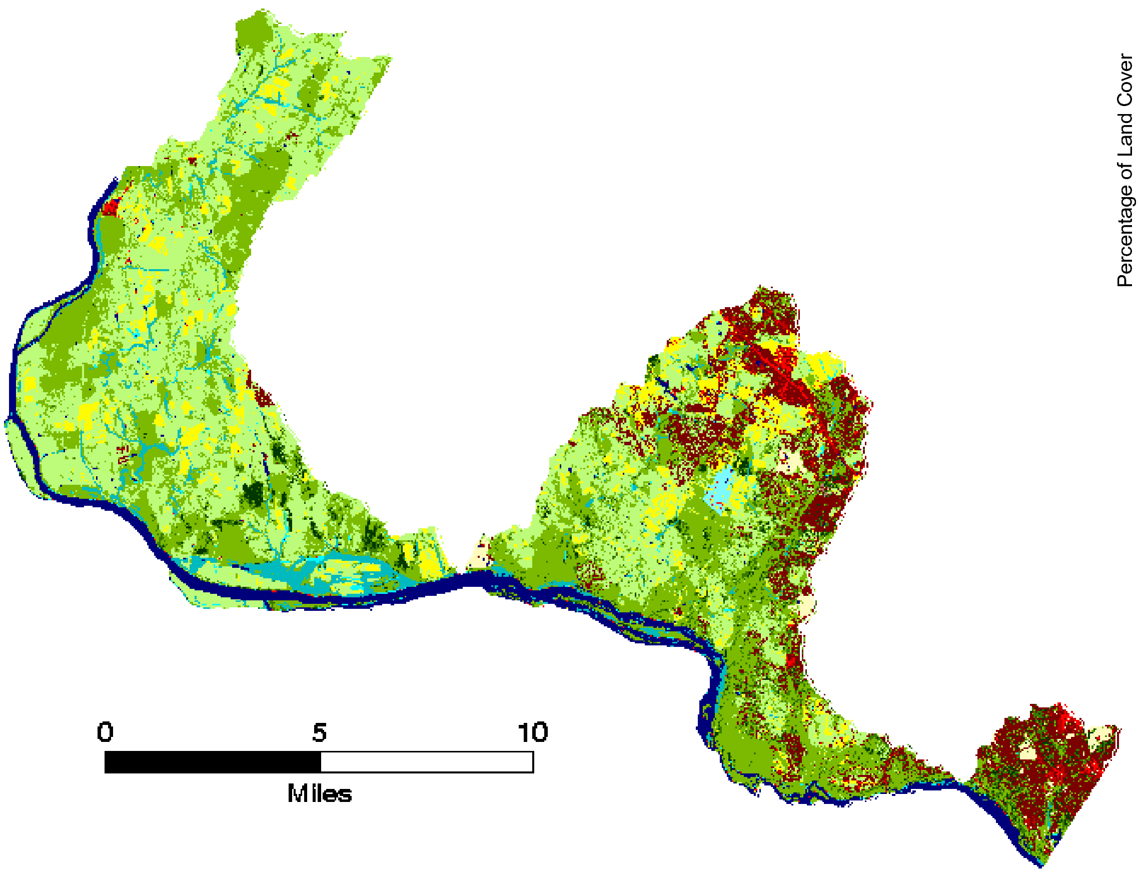
Potomac River Lower Tidal/Potomac River Middle Tidal

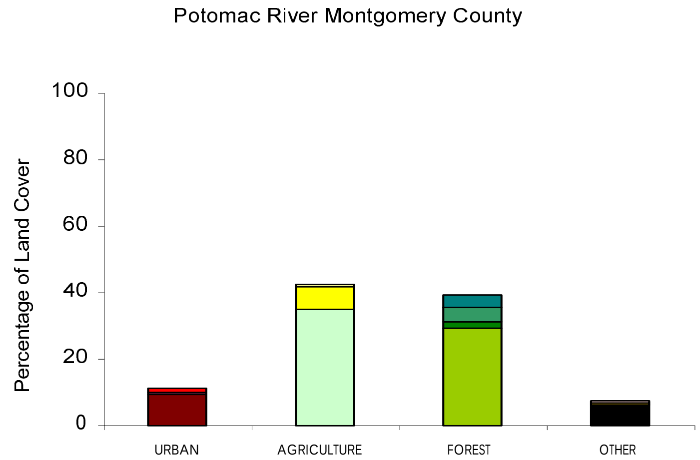
Potomac River
Montgomery County watershed
MB





Potomac River Montgomery County





Potomac River Montgomery County

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
PRMO-101-R-2002	Horsepen Br Ut	021402020850	Potomac River (Montgomery County)	Washington Metro	Montgomery	5-Mar-02	10-Jun-02	1	195
PRMO-103-R-2002	Rock Run	021402020845	Potomac River (Montgomery County)	Washington Metro	Montgomery	5-Mar-02	25-Jun-02	1	319
PRMO-109-R-2002	Willett Br	021402020844	Potomac River (Montgomery County)	Washington Metro	Montgomery	5-Mar-02	12-Jun-02	1	912
PRMO-110-R-2002	Broad Run	021402020851	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	10-Jun-02	1	1576
PRMO-112-R-2002	Green Briar Br	021402020846	Potomac River (Montgomery County)	Washington Metro	Montgomery	5-Mar-02	12-Jun-02	1	853
PRMO-114-R-2002	Little Monocacy R Ut 2	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	12-Jun-02	1	331
PRMO-115-R-2002	Little Monocacy R Ut 2	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	12-Jun-02	1	392
PRMO-120-R-2002	Little Monocacy R Ut 1	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	24-Jun-02	1	343
PRMO-202-R-2002	Broad Run	021402020851	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	24-Jun-02	2	6456
PRMO-222-R-2002	Watts Br	021402020846	Potomac River (Montgomery County)	Washington Metro	Montgomery	5-Mar-02	25-Jun-02	2	6889
PRMO-304-R-2002	Little Monocacy R	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	6-Mar-02	11-Jun-02	3	5446
PRMO-307-R-2002	Little Monocacy R	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	24-Jun-02	3	11435
PRMO-311-R-2002	Little Monocacy R	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	10-Jun-02	3	11960
PRMO-313-R-2002	Horsepen Br	021402020850	Potomac River (Montgomery County)	Washington Metro	Montgomery	4-Mar-02	11-Jun-02	3	3803
PRMO-323-R-2002	Little Monocacy R	021402020853	Potomac River (Montgomery County)	Washington Metro	Montgomery	6-Mar-02	11-Jun-02	3	5619

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
PRMO-101-R-2002	NS	1.67	NS	NS	NS
PRMO-103-R-2002	1.57	2.56	19.81	0	0
PRMO-109-R-2002	1.00	1.00	6.13	0	0
PRMO-110-R-2002	3.86	4.11	63.33	0	0
PRMO-112-R-2002	3.29	3.89	57.96	0	0
PRMO-114-R-2002	2.43	3.67	72.23	0	0
PRMO-115-R-2002	2.71	4.33	50.87	0	0
PRMO-120-R-2002	1.29	3.22	16.76	0	0
PRMO-202-R-2002	3.57	3.89	94.79	0	0
PRMO-222-R-2002	3.57	2.78	80.95	0	0
PRMO-304-R-2002	3.29	4.33	97.53	0	0
PRMO-307-R-2002	3.57	3.67	59.45	0	0
PRMO-311-R-2002	3.29	3.22	85.50	0	0
PRMO-313-R-2002	2.43	3.00	30.47	0	0
PRMO-323-R-2002	3.57	3.67	81.58	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
PRMO-101-R-2002	0.00	18.05	68.22	13.73	0.00
PRMO-103-R-2002	28.55	28.34	39.83	3.27	9.26
PRMO-109-R-2002	60.09	6.85	33.01	0.05	18.58
PRMO-110-R-2002	0.01	68.79	27.59	3.60	0.01
PRMO-112-R-2002	0.52	14.74	70.49	14.25	0.38
PRMO-114-R-2002	0.00	17.35	82.65	0.00	0.00
PRMO-115-R-2002	0.00	22.83	76.32	0.85	0.00
PRMO-120-R-2002	0.39	81.48	17.35	0.78	0.23
PRMO-202-R-2002	0.50	72.20	25.65	1.65	0.17
PRMO-222-R-2002	37.51	26.66	34.44	1.39	11.58
PRMO-304-R-2002	0.33	68.93	30.14	0.60	0.11
PRMO-307-R-2002	0.39	61.42	37.68	0.51	0.12
PRMO-311-R-2002	0.42	61.47	37.60	0.51	0.13
PRMO-313-R-2002	3.01	57.71	37.76	1.52	0.80
PRMO-323-R-2002	0.31	69.39	29.71	0.58	0.10

Potomac River Montgomery County

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (□eq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
PRMO-101-R-2002	6.78	138.4	753.2	8.789	0.001	10.018	0.1126	0.0224	0.0026	0.0098	0.4642	13.3834	NS	NS
PRMO-103-R-2002	6.95	764.1	1532.8	174.189	0.776	15.604	0.0187	0.0007	0.0042	0.0316	0.9201	4.1064	5.6	4.6
PRMO-109-R-2002	7.81	630.6	1912.4	98.546	3.078	43.126	0.0570	0.0223	0.0378	0.0232	3.2416	2.5448	9.2	1.1
PRMO-110-R-2002	7.40	177.1	550.1	22.773	0.716	14.791	0.0130	0.0053	0.0053	0.0130	0.9959	7.7153	9.3	2.5
PRMO-112-R-2002	7.81	427.5	3069.3	23.664	0.652	19.127	0.0091	0.0047	0.0039	0.0098	0.8005	4.6986	6.3	3.6
PRMO-114-R-2002	6.72	84.0	258.4	8.176	0.687	6.017	0.0094	0.0039	0.0009	0.0066	0.7359	1.6007	8.5	2.6
PRMO-115-R-2002	6.91	82.0	265.2	8.119	0.695	5.894	0.0056	0.0041	0.0017	0.0063	0.7249	1.5630	8.5	2.6
PRMO-120-R-2002	7.61	429.6	1322.5	45.525	1.601	50.755	0.0514	0.0346	0.0030	0.0087	1.6621	3.3817	8.8	4.7
PRMO-202-R-2002	7.38	208.6	635.3	22.212	1.902	18.454	0.0333	0.0061	0.0085	0.0178	2.1531	6.1644	9.4	9.9
PRMO-222-R-2002	7.57	404.1	875.1	97.976	1.375	14.021	0.0162	0.0007	0.0053	0.0045	1.4423	2.7215	8.9	1.9
PRMO-304-R-2002	7.51	147.2	636.7	13.959	1.836	7.332	0.0140	0.0037	0.0062	0.0135	1.9229	1.8842	7.1	7.9
PRMO-307-R-2002	7.60	176.5	650.5	18.987	1.948	10.123	0.0220	0.0040	0.0117	0.0154	1.9902	3.5896	8.4	3.2
PRMO-311-R-2002	7.78	175.3	669.4	19.102	1.907	11.020	0.0226	0.0042	0.0123	0.0103	1.9631	3.1936	8.4	2.2
PRMO-313-R-2002	7.54	272.1	1087.9	32.624	0.583	19.724	0.0415	0.0061	0.0050	0.0125	0.8050	4.8891	6.6	7.1
PRMO-323-R-2002	7.44	156.4	628.2	13.889	1.818	7.319	0.0145	0.0034	0.0054	0.0122	1.8914	1.8471	9.9	7.6

Physical Habitat Condition

Site	Riparian Buffer Width	Riparian Buffer Width	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
PRMO-101-R-2002	50	50	OF	TG										18	
PRMO-103-R-2002	50	15	LN	PK	11	12	7	10	60	6	25	25	98	6	50
PRMO-109-R-2002	0	0	PK	PK	1	6	6	0	0	11	75	0	99	2	8
PRMO-110-R-2002	50	48	FR	PV	16	14	13	10	65	11	12	30	90	16	44
PRMO-112-R-2002	50	50	LN	FR	16	13	10	15	40	10	35	45	85	18	62
PRMO-114-R-2002	50	50	TG	TG	16	15	8	10	56	12	19	20	90	17	46
PRMO-115-R-2002	50	0	TG	PA	16	16	7	10	46	12	42	25	98	17	44
PRMO-120-R-2002	50	50	FR	FR	10	11	8	8	30	7	45	35	92	19	44
PRMO-202-R-2002	50	50	FR	FR	16	13	15	16	55	16	30	35	85	18	69
PRMO-222-R-2002	50	50	FR	FR	16	16	14	13	40	14	45	30	80	17	88
PRMO-304-R-2002	50	50	FR	TG	16	13	14	17	62	13	13	25	85	19	81
PRMO-307-R-2002	50	50	FR	FR	14	16	13	13	60	15	30	20	70	3	72
PRMO-311-R-2002	50	50	FR	FR	17	16	15	15	45	15	40	30	84	16	53
PRMO-313-R-2002	50	50	FR	TG	6	7	6	8	65	6	15	45	88	17	47
PRMO-323-R-2002	50	50	TG	TG	16	14	14	15	60	15	18	40	35	18	63

Potomac River Montgomery County
Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
PRMO-101-R-2002	N	N	N	N	NS	NS	NS
PRMO-103-R-2002	Y	N	N	N	Severe	Severe	Mild
PRMO-109-R-2002	Y	N	N	Y	None	None	None
PRMO-110-R-2002	N	N	N	N	Mild	Mild	Mild
PRMO-112-R-2002	Y	N	N	N	Moderate	Moderate	Moderate
PRMO-114-R-2002	Y	N	N	N	None	Moderate	Moderate
PRMO-115-R-2002	Y	N	Y	N	Moderate	Moderate	Mild
PRMO-120-R-2002	N	N	N	N	Severe	None	Moderate
PRMO-202-R-2002	N	N	N	N	Moderate	Moderate	Severe
PRMO-222-R-2002	N	N	N	N	Moderate	Severe	Severe
PRMO-304-R-2002	Y	N	N	N	Moderate	Severe	Severe
PRMO-307-R-2002	N	N	N	N	Moderate	Mild	Severe
PRMO-311-R-2002	N	N	N	N	None	Mild	Moderate
PRMO-313-R-2002	N	N	N	N	Mild	None	Moderate
PRMO-323-R-2002	Y	N	N	N	None	Moderate	Mild

Interpretation of Watershed Condition

- Several sites in highly urbanized catchments
- Chloride, nitrogen, and phosphorus values elevated at several sites
- Physical habitat condition generally good
- Erosion and bar formation problematic at several sites

Potomac River Montgomery County

Fish Species Present

BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BLUNTNOSE MINNOW
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
CREEK CHUBSUCKER
CUTLIPS MINNOW
EASTERN MUDMINNOW
EASTERN SILVERY MINNOW
FALLFISH
FANTAIL DARTER
FATHEAD MINNOW
GREEN SUNFISH
GREENSIDE DARTER
LARGEMOUTH BASS
LONGNOSE DACE
MOSQUITOFISH
NORTHERN HOGSUCKER
POTOMAC SCULPIN
PUMPKINSEED
RAINBOW DARTER
REDBREAST SUNFISH
ROCK BASS
ROSYSIDE DACE
SILVERJAW MINNOW
SMALLMOUTH BASS
SPOTFIN SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
BAETIDAE
BAETIS
BEZZIA
BOYERIA
BRILLIA
CAECIDOTEA
CAENIS
CALOPTERYX
CAMBARIDAE
CAPNIIDAE
CENTROPTILUM
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMUS
CLINOCERA
CLIOPERLA
COENAGRIONIDAE
CONCHAPELOPIA
CORYDALUS
CORYNONEURA
CRANGONYX
CRICOTOPUS/ORTHOCLADIUS
CURCULIONIDAE
DIAMESA
DIAMESINAE
DICRANOTA
DICROTENDIPES
DINEUTUS
DIPHETOR
DIPLECTRONA
DIPLOCLADIUS
DOLOPHILODES
DUBIRAPHIA
DUGESIA
ECCOPTURA
ENCHYTRAEIDAE
EPHEMERELLA
EPHEMERELLIDAE
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GAMMARUS
GLOSSOSOMA
GOMPHIDAE
GORDIIDAE
HEMERODROMIA
HEPTAGENIIDAE
HEXATOMA
HIRUDINEA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
HYDROPSYCHIDAE
ISONYCHIA
ISOPERLA
ISOTOMURUS
LARSIA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LUMBRICULIDAE
LYPE
MENETUS
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MUSCULIUM
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
NEOPHYLAX
NIGRONIA
OECETIS
OEMOPTERYX
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARACAPNIA
PARAKIEFFERIELLA
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATANYTARSUS
PARATENDIPES
PELTODYTES
PERLIDAE
PERLODIDAE
PHAENOPSECTRA
PHYSELLA
PLANARIIDAE
PLATYSMITTIA
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROSIMULIUM
PROSTOIA
PSEPHENUS
PTILOSTOMIS
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIMULIIDAE
SIMULIUM
SPHAERIIDAE
SPHAERIUM
STEGOPTERNA
STEMPELLINELLA
STENACRON
STENELMIS
STENONEMA
STICTOCHIRONOMUS
STROPHOPTERYX
SYMPOSIOCLADIUS
SYMPOTTHASTIA
TABANUS
TAENIOPTERYX
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRIBELOS
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

Potomac River Montgomery County

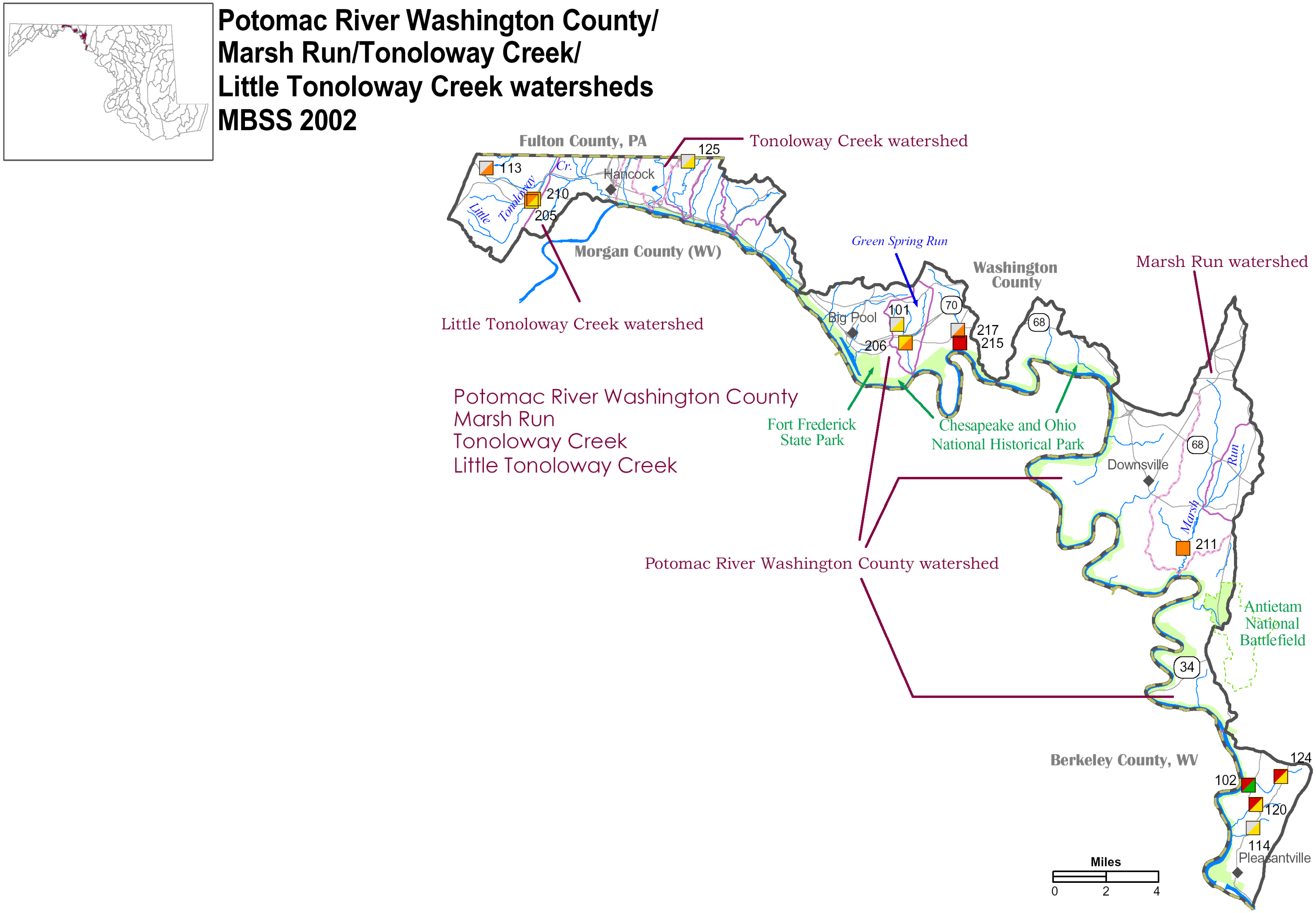
Herpetofauna Present

AMERICAN TOAD
BULLFROG
COMMON SNAPPING TURTLE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
RED SALAMANDER
WOOD FROG

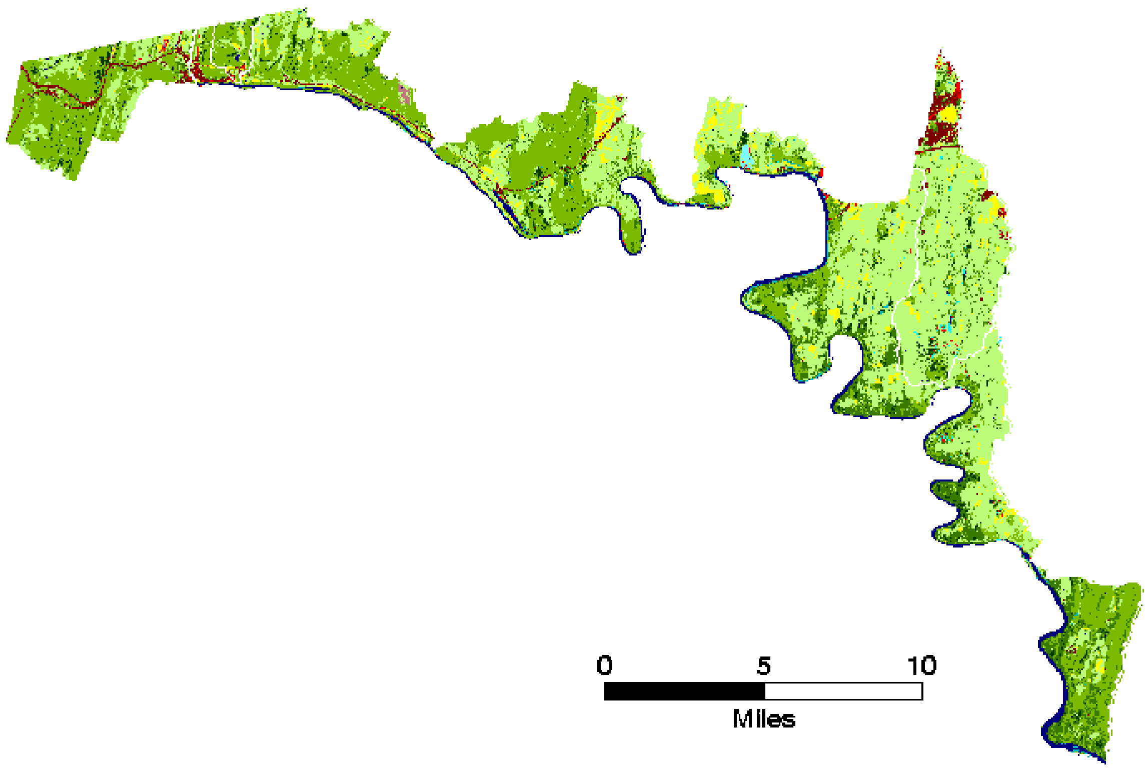
Potomac River Montgomery County

Stream Waders Data
No Stream Waders data for 2002

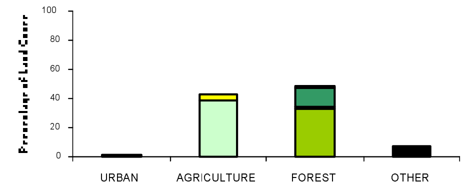
Potomac River Washington County/ Marsh Run/Tonoloway Creek/ Little Tonoloway Creek watersheds MBSS 2002



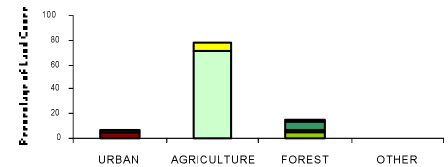
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway



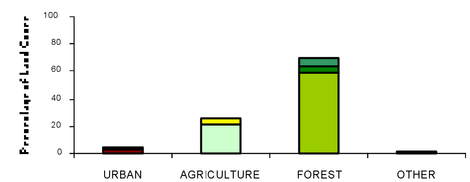
Potomac River Washington County



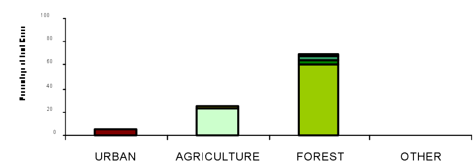
Marsh Run



Tonoloway Creek



Little Tonoloway Creek



Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
LTON-113-R-2002	Sawmill Hollow	021405090153	Little Tonoloway Creek	Upper Potomac	Washington	25-Mar-02	20-Jun-02	1	89
LTON-205-R-2002	Little Tonoloway	021405090153	Little Tonoloway Creek	Upper Potomac	Washington	7-Mar-02	20-Jun-02	2	3874
LTON-210-R-2002	Little Tonoloway	021405090153	Little Tonoloway Creek	Upper Potomac	Washington	7-Mar-02	20-Jun-02	2	3918
MARS-211-R-2002	Marsh Run	021405030185	Marsh Run	Upper Potomac	Washington	19-Mar-02	25-Jun-02	2	12757
PRWA-101-R-2002	Green Spring Run	021405010162	Potomac River (Washington County)	Upper Potomac	Washington	25-Mar-02	9-Jul-02	1	324
PRWA-102-R-2002	Frog Hollow	021405010167	Potomac River (Washington County)	Upper Potomac	Washington	6-Mar-02	26-Jun-02	1	1900
PRWA-114-R-2002	Potomac R Ut 1	021405010167	Potomac River (Washington County)	Upper Potomac	Washington	6-Mar-02	26-Jun-02	1	277
PRWA-120-R-2002	Potomac R Ut 2	021405010167	Potomac River (Washington County)	Upper Potomac	Washington	6-Mar-02	26-Jun-02	1	531
PRWA-124-R-2002	Frog Hollow	021405010167	Potomac River (Washington County)	Upper Potomac	Washington	6-Mar-02	26-Jun-02	1	494
PRWA-125-R-2002	Ditch Run Ut	021405010157	Potomac River (Washington County)	Upper Potomac	Washington	25-Mar-02	10-Jul-02	1	91
PRWA-206-R-2002	Green Spring Run	021405010162	Potomac River (Washington County)	Upper Potomac	Washington	25-Mar-02	10-Jul-02	2	1658
PRWA-215-R-2002	Camp Spring Run	021405010163	Potomac River (Washington County)	Upper Potomac	Washington	7-Mar-02	10-Jul-02	2	2020
PRWA-217-R-2002	Camp Spring Run	021405010163	Potomac River (Washington County)	Upper Potomac	Washington	7-Mar-02	9-Jul-02	2	1511

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
LTON-113-R-2002	NR	2.33	5.68	0	0
LTON-205-R-2002	2.43	3.22	61.89	0	0
LTON-210-R-2002	2.14	3.67	19.49	0	0
MARS-211-R-2002	2.14	2.33	83.06	0	0
PRWA-101-R-2002	NS	3.67	NS	NS	NS
PRWA-102-R-2002	1.86	4.11	3.48	0	0
PRWA-114-R-2002	NS	3.44	NS	NS	NS
PRWA-120-R-2002	1.29	3.44	5.79	0	0
PRWA-124-R-2002	1.00	3.67	8.47	0	0
PRWA-125-R-2002	NS	3.44	NS	NS	NS
PRWA-206-R-2002	3.57	2.78	72.63	0	0
PRWA-215-R-2002	1.29	1.89	93.04	0	0
PRWA-217-R-2002	NS	2.33	NS	NS	NS

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
LTON-113-R-2002	9.90	2.97	84.16	2.97	7.43
LTON-205-R-2002	3.49	11.72	84.30	0.49	0.90
LTON-210-R-2002	3.74	11.86	83.91	0.07	0.96
MARS-211-R-2002	7.90	78.30	13.05	0.74	3.14
PRWA-101-R-2002	0.00	4.66	95.27	0.07	0.00
PRWA-102-R-2002	0.07	5.27	94.64	0.02	0.02
PRWA-114-R-2002	0.48	33.06	66.21	0.24	0.16
PRWA-120-R-2002	0.00	21.08	78.29	0.63	0.00
PRWA-124-R-2002	0.00	5.49	94.46	0.05	0.00
PRWA-125-R-2002	0.00	55.96	44.04	0.00	0.00
PRWA-206-R-2002	1.78	7.00	91.14	0.08	1.25
PRWA-215-R-2002	4.28	63.06	32.56	0.10	2.58
PRWA-217-R-2002	3.72	59.35	36.85	0.07	2.22

Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
LTON-113-R-2002	4.35	1370.1	-51.4	246.652	2.266	292.941	0.0055	0.0007	0.0004	0.0312	2.2445	2.2336	7.7	0.2
LTON-205-R-2002	7.19	411.2	602.7	77.243	0.197	24.458	0.0076	0.0007	0.0013	0.0065	0.2530	1.9178	9.1	2.9
LTON-210-R-2002	7.34	408.7	604.7	81.669	0.181	24.823	0.0078	0.0007	0.0004	0.0053	0.2413	2.1535	9.1	2.9
MARS-211-R-2002	8.12	710.0	5335.7	48.027	2.972	36.166	0.0225	0.0007	0.0217	0.0466	3.0943	2.6926	7.1	6.5
PRWA-101-R-2002	6.95	164.4	495.8	11.952	0.536	23.920	0.0125	0.0030	0.0033	0.0079	0.6655	3.0025	NS	NS
PRWA-102-R-2002	6.89	144.7	396.5	20.405	0.383	10.736	0.0061	0.0007	0.0007	0.0054	0.4101	1.5162	4.2	1.2
PRWA-114-R-2002	7.00	130.4	358.3	17.870	0.203	8.350	0.0098	0.0028	0.0007	0.0078	0.2736	2.0638	NS	NS
PRWA-120-R-2002	7.29	158.3	539.4	21.912	0.635	8.038	0.0114	0.0030	0.0037	0.0218	0.7355	2.5932	6.6	2.2
PRWA-124-R-2002	7.30	124.9	473.6	14.159	0.569	8.044	0.0043	0.0007	0.0008	0.0065	0.6082	2.5542	6.2	1.5
PRWA-125-R-2002	7.15	137.5	336.2	8.239	1.880	20.857	0.0097	0.0036	0.0026	0.0042	1.9510	2.2975	NS	NS
PRWA-206-R-2002	8.11	443.1	2409.5	46.989	0.606	18.001	0.0186	0.0028	0.0015	0.0067	0.6428	1.5807	10.7	3
PRWA-215-R-2002	8.16	499.7	3529.5	24.697	5.507	12.601	0.0265	0.0007	0.0048	0.0140	5.4761	1.1509	10.9	4.9
PRWA-217-R-2002	8.48	752.5	4538.6	69.034	2.332	28.984	0.0323	0.0007	0.0104	0.0143	2.5174	3.7945	NS	NS

Physical Habitat Condition

Site	Riparian Buffer Width	Riparian Buffer Width	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
LTON-113-R-2002	50	50	FR	FR	6	10	6	4	55	6	20	50	95	15	18
LTON-205-R-2002	50	50	FR	TG	15	14	13	14	65	8	15	35	90	19	83
LTON-210-R-2002	0	0	PV	PV	13	14	5	10	40	6	35	40	80	10	31
MARS-211-R-2002	50	50	FR	TG	12	5	14	14	60	12	15	85	75	10	70
PRWA-101-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	19	NS
PRWA-102-R-2002	50	40	FR	CP	6	2	4	8	24	0	0	15	90	16	42
PRWA-114-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	17	NS
PRWA-120-R-2002	0	0	PA	PA	9	11	5	7	46	6	29	35	45	5	27
PRWA-124-R-2002	50	50	FR	FR	8	11	5	6	45	6	20	35	86	18	21
PRWA-125-R-2002	50	32	FR	OF	NS	NS	NS	NS	NS	NS	NS	NS	NS	19	NS
PRWA-206-R-2002	0	0	PA	PA	16	14	12	11	21	16	54	35	45	16	51
PRWA-215-R-2002	0	0	PA	PA	16	12	10	10	43	14	32	40	70	15	34
PRWA-217-R-2002	50	33	TG	PV	NS	NS	NS	NS	NS	NS	NS	NS	NS	18	NS

Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
LTON-113-R-2002	N	N	N	N	None	Mild	None
LTON-205-R-2002	N	N	N	N	Mild	Mild	Moderate
LTON-210-R-2002	Y	N	N	Y	None	None	Mild
MARS-211-R-2002	N	N	N	N	Moderate	None	None
PRWA-101-R-2002	N	N	N	N	NS	NS	NS
PRWA-102-R-2002	N	N	N	Y	Mild	None	Mild
PRWA-114-R-2002	N	N	N	N	NS	NS	NS
PRWA-120-R-2002	Y	N	N	N	Moderate	Mild	Mild
PRWA-124-R-2002	N	N	N	N	Mild	Mild	Mild
PRWA-125-R-2002	N	N	N	N	NS	NS	NS
PRWA-206-R-2002	Y	N	N	N	Moderate	Mild	None
PRWA-215-R-2002	Y	N	N	N	Severe	Mild	Moderate
PRWA-217-R-2002	Y	N	N	Y	NS	NS	NS

Interpretation of Watershed Condition

- Chloride, nitrogen, and phosphorus levels elevated at some sites
- Several sites with no riparian buffer
- Channelization evident at some sites

Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

Fish Species Present
BLACKNOSE DACE
BLUEGILL
BLUNTNOSE MINNOW
BROWN TROUT
COMMON SHINER
CREEK CHUB
FANTAIL DARTER
GREEN SUNFISH
GREENSIDE DARTER
LARGEMOUTH BASS
PEARL DACE
POTOMAC SCULPIN
PUMPKINSEED
REDBREAST SUNFISH
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present
JAPANESE HONEYSUCKLE
MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present
ABLABESMYIA
AMELETUS
AMPHINEMURA
ANTOCHA
BAETIDAE
BAETIS
CAECIDOTEA
CAENIS
CAMBARIDAE
CAPNIIDAE
CENTROPTILUM
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINI
CHIRONOMUS
CLINOTANYPUS
CLIOPERLA
CONCHAPELOPIA
CORDULEGASTER
CORYNONEURA
CRANGONYX
CRYPTOCHIRONOMUS
CULICOIDES
DASYHELEA
DIAMESA
DIAMESINAE
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DIXIDAE
DOLICHOPODIDAE
DOLOPHILODES
DUBIRAPHIA
DUGESIA
DYTISCIDAE
ECTOPRIA
EMPIDIDAE
ENCHYTRAEIDAE
EPHEMERELLA
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GAMMARUS
GOMPHIDAE
HELENIELLA
HELICHUS
HETEROTRISSOCLADIUS
HEXATOMA
HYDROBAENUS
HYDROBIUS
HYDROPORUS
HYDROPSYCHE
ISOPERLA
ISOTOMURUS
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCTRA
LEUCTRIDAE
LIMNEPHILUS
LIMNOPHYES
LIRCEUS
LUMBRICULIDAE
LYMNAEIDAE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
MOLANNODES
NAIDIDAE
NATARSIA
NEMOURIDAE
NEOPHYLAX
NIGRONIA
ODONATA
OEMOPTERYX
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OSTROCERCA
OULIMNIUS
PARACAPNIA
PARACHAETOCLADIUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARALEUCTRA
PARAMERINA
PARAMETRIOCNEMUS
PARANEMOURA
PARAPHAENOCLADIUS
PERLODIDAE
PHAENOPSECTRA
PHAGOCATA
PHYSELLA
PLANARIIDAE
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PROSIMULIUM
PROSTOIA
PSEPHENUS
PSEUDOLIMNOPHILA
PSEUDORTHOCLADIUS
PYCNOPSYCHE
PYRALIDAE
RHEOCRICOTOPUS
RHYACOPHILA
SCIRTIDAE
SIALIS
SIMULIUM
SPHAERIIDAE
SPHAERIUM
SPIROSPERMA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENONEMA
STICTOCHIRONOMUS
SUBLETTEA
SYMPOSIOCLADIUS
SYMPOTTHASTIA
TABANIDAE
TAENIOPTERYX
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
ZAVRELIMYIA

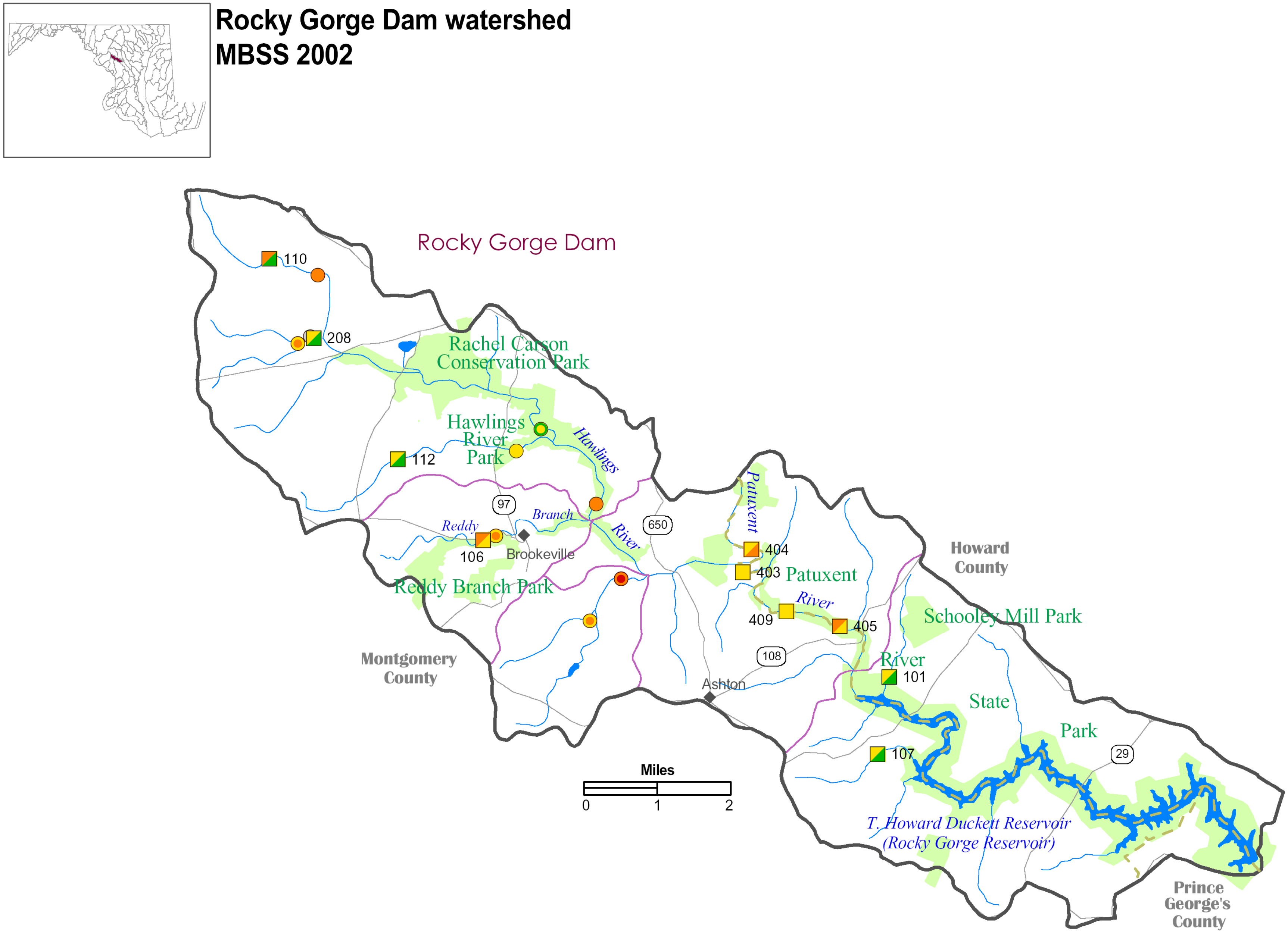
Herpetofauna Present
BULLFROG
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN SPRING SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
WOOD FROG
WOOD TURTLE

Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

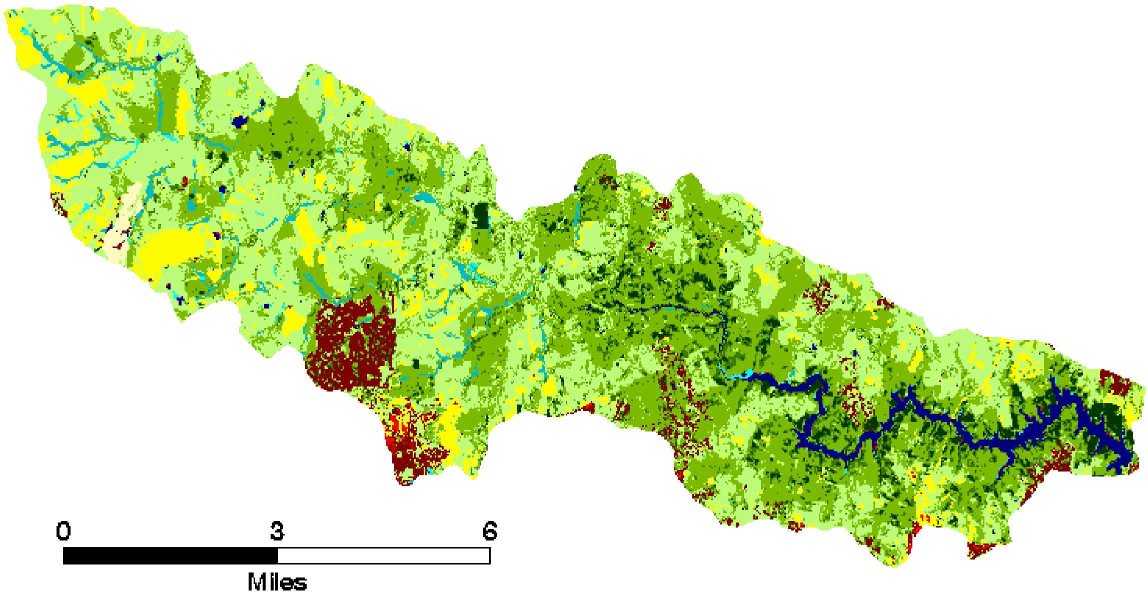
Stream Waders Data
No Stream Waders data for 2002

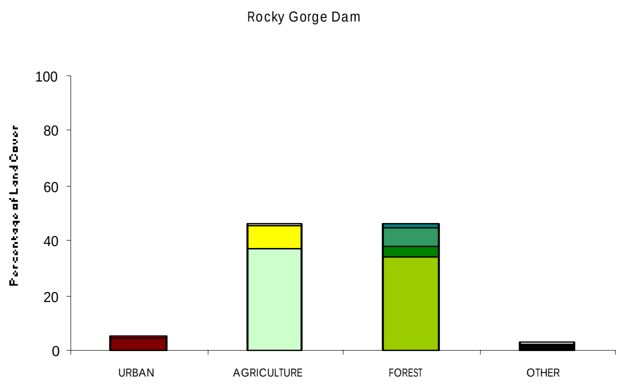
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway

Rocky Gorge Dam watershed
MBSS 2002



Rocky Gorge Dam





Rocky Gorge Dam

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
RKGR-101-R-2002	Rocky Gorge Res Ut 2	021311070941	Rocky Gorge Dam	Patuxent River	Howard	13-Mar-02	2-Jul-02	1	873
RKGR-106-R-2002	Reddy Br	021311070944	Rocky Gorge Dam	Patuxent River	Montgomery	13-Mar-02	26-Jun-02	1	1257
RKGR-107-R-2002	Rocky Gorge Res Ut 3	021311070941	Rocky Gorge Dam	Patuxent River	Montgomery	13-Mar-02	26-Jun-02	1	849
RKGR-110-R-2002	Hawlings R	021311070945	Rocky Gorge Dam	Patuxent River	Montgomery	13-Mar-02	1-Jul-02	1	557
RKGR-112-R-2002	Hawling R Ut 2	021311070945	Rocky Gorge Dam	Patuxent River	Montgomery	4-Apr-02	1-Jul-02	1	1059
RKGR-208-R-2002	Hawling R Ut 1	021311070945	Rocky Gorge Dam	Patuxent River	Montgomery	4-Apr-02	2-Jul-02	2	1336
RKGR-403-R-2002	Patuxent R	021311070942	Rocky Gorge Dam	Patuxent River	Howard/ Montgomery	19-Mar-02	5-Aug-02	4	69342
RKGR-404-R-2002	Patuxent R	021311070942	Rocky Gorge Dam	Patuxent River	Howard/ Montgomery	20-Mar-02	5-Aug-02	4	51335
RKGR-405-R-2002	Patuxent R	021311070942	Rocky Gorge Dam	Patuxent River	Howard/ Montgomery	19-Mar-02	1-Jul-02	4	71318
RKGR-409-R-2002	Patuxent R	021311070942	Rocky Gorge Dam	Patuxent River	Howard/ Montgomery	19-Mar-02	1-Jul-02	4	70745

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
RKGR-101-R-2002	3.22	4.33	81.58	0	0
RKGR-106-R-2002	2.78	3.67	52.40	0	0
RKGR-107-R-2002	3.22	4.11	84.99	0	0
RKGR-110-R-2002	2.78	4.56	86.00	0	0
RKGR-112-R-2002	3.00	4.33	74.62	0	0
RKGR-208-R-2002	3.00	4.33	81.88	0	0
RKGR-403-R-2002	3.00	3.00	98.45	0	0
RKGR-404-R-2002	3.00	2.56	99.32	0	0
RKGR-405-R-2002	2.56	3.67	6.88	0	0
RKGR-409-R-2002	3.00	3.89	91.59	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
RKGR-101-R-2002	2.68	44.46	52.74	0.13	0.67
RKGR-106-R-2002	7.83	62.45	28.67	1.06	1.97
RKGR-107-R-2002	7.67	48.82	43.24	0.26	2.04
RKGR-110-R-2002	0.00	75.43	23.29	1.28	0.00
RKGR-112-R-2002	0.31	71.05	26.99	1.64	0.23
RKGR-208-R-2002	1.75	80.84	15.37	2.03	0.47
RKGR-403-R-2002	2.28	61.18	34.36	2.17	0.83
RKGR-404-R-2002	1.00	61.95	34.46	2.59	0.44
RKGR-405-R-2002	2.25	60.10	35.51	2.14	0.81
RKGR-409-R-2002	2.26	60.46	35.14	2.14	0.82

Interpretation of Watershed Condition

- Two sites in highly agricultural watersheds
- Nitrogen and phosphorus levels elevated throughout watershed
- Turbidity high at several sites
- Physical habitat condition generally good
- Erosion severe at some sites

Rocky Gorge Dam

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
RKGR-101-R-2002	7.46	142.1	612.7	15.909	1.579	5.413	0.0118	0.0021	0.0072	0.0084	1.6397	2.4242	7.6	1.1
RKGR-106-R-2002	6.90	160.9	447.8	23.854	2.695	6.084	0.0509	0.0069	0.0120	0.0325	2.7625	4.6540	5.9	12.9
RKGR-107-R-2002	7.15	124.0	391.9	14.870	2.312	4.305	0.0935	0.0615	0.0067	0.0456	2.4320	3.6110	7	7.4
RKGR-110-R-2002	6.93	90.4	258.2	7.518	3.149	3.277	0.0289	0.0061	0.0073	0.0164	3.3139	3.4288	6.9	8.5
RKGR-112-R-2002	7.17	139.7	566.2	11.128	1.903	7.866	0.0342	0.0047	0.0068	0.0203	2.1286	4.4384	6.3	8.1
RKGR-208-R-2002	7.22	96.9	225.3	10.577	3.133	1.701	0.0168	0.0048	0.0059	0.0103	3.1872	1.2442	6.3	13.5
RKGR-403-R-2002	7.87	163.9	491.6	23.872	1.983	6.480	0.0294	0.0007	0.0133	0.0300	2.0600	2.2107	5.5	13.8
RKGR-404-R-2002	7.36	153.4	480.1	20.708	1.883	5.474	0.0360	0.0007	0.0127	0.0697	2.0473	2.1085	5.6	17.4
RKGR-405-R-2002	7.35	169.9	523.2	24.253	1.803	6.674	0.0308	0.0007	0.0127	0.0335	1.9191	2.4737	5.3	9.8
RKGR-409-R-2002	7.56	167.3	508.3	24.413	1.831	6.614	0.0278	0.0007	0.0119	0.0289	1.9526	2.2400	6	11.1

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
RKGR-101-R-2002	50	50	FR	FR	16	15	8	9	26	13	49	40	85	15	44
RKGR-106-R-2002	50	48	FR	PV	14	13	12	14	51	12	24	30	80	11	72
RKGR-107-R-2002	50	50	FR	FR	16	17	13	14	33	14	42	20	87	15	61
RKGR-110-R-2002	15	30	CP	CP	16	14	13	15	60	13	15	40	85	17	67
RKGR-112-R-2002	50	30	FR	CP	15	13	11	12	49	11	26	20	89	17	53
RKGR-208-R-2002	50	50	TG	FR	14	14	13	14	65	14	25	25	95	17	97
RKGR-403-R-2002	50	50	FR	FR	16	13	11	14	75	16	4	70	80	17	92
RKGR-404-R-2002	50	0	TG	PA	16	13	14	18	70	16	12	35	72	18	131
RKGR-405-R-2002	50	50	FR	FR	13	8	10	18	75	0	0	90	80	17	128
RKGR-409-R-2002	50	50	FR	FR	16	11	9	18	75	0	0	90	85	16	120

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
RKGR-101-R-2002	Y	N	N	N	Moderate	Moderate	Severe
RKGR-106-R-2002	N	N	N	N	Moderate	Moderate	Moderate
RKGR-107-R-2002	N	N	N	N	Moderate	Severe	Mild
RKGR-110-R-2002	N	N	N	N	Moderate	Moderate	Mild
RKGR-112-R-2002	N	N	N	N	Moderate	Moderate	Moderate
RKGR-208-R-2002	N	N	N	N	Moderate	Moderate	Mild
RKGR-403-R-2002	N	N	N	N	Severe	Mild	Moderate
RKGR-404-R-2002	Y	N	N	N	Moderate	Moderate	Mild
RKGR-405-R-2002	N	N	N	N	Severe	Mild	Moderate
RKGR-409-R-2002	N	N	N	N	Severe	Moderate	Mild

Rocky Gorge Dam

Fish Species Present

BLACK CRAPPIE
BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BROWN BULLHEAD
CENTRAL STONEROLLER
COMMON CARP
CREEK CHUB
CUTLIPS MINNOW
FALLFISH
GIZZARD SHAD
GOLDEN SHINER
GREEN SUNFISH
LARGEMOUTH BASS
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
PUMPKINSEED
REDBREAST SUNFISH
RIVER CHUB
ROSYSIDE DACE
SATINFIN SHINER
SHIELD DARTER
SHORTHEAD REDHORSE
SPOTFIN SHINER
SPOTTAIL SHINER
SWALLOWTAIL SHINER
TESSELLATED DARTER
WHITE PERCH
WHITE SUCKER
YELLOW BULLHEAD
YELLOW PERCH

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
ACRONEURIA
AMELETUS
AMPHINEMURA
ANCHYTARSUS
ANTOCHA
BAETIDAE
BEZZIA
BRILLIA
CENTROPTILUM
CERATOPOGONIDAE
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMINI
CHRYSOPS
CONCHAPELOPIA
CORIXIDAE
CORYNONEURA
CRANGONYX
CRICOTOPUS
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOPERLA
DIXA
DIXELLA
DOLOPHILODES
DUBIRAPHIA
DUGESIA
ECCOPTURA
ELMIDAE
EMPIDIDAE
EPEORUS
EPHEMERELLA
EPHEMERELLIDAE
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GLOSSOSOMA
GLYPTOTENDIPES
GOMPHIDAE
HEMERODROMIA
HEPTAGENIIDAE
HEXATOMA
HOMOPLECTRA
HYALELLA
HYDROBAENUS
HYDROPORUS
HYDROPSYCHE
ISONYCHIA
ISOPERLA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCROCUTA
LEUCTRIDAE
LIMNODRILUS
LIMNOPHYES
LUMBRICULIDAE
LYPE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MUSCULIUM
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
NEOPHYLAX
NIGRONIA
OLIGOCHAETA
OPTIOSERVUS
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARAKIEFFERIELLA
PARAMETRIOCNEMUS
PARATANYTARSUS
PERLODIDAE
PHYSELLA
PLECOPTERA
POLYCENTROPUS
POLYPEDILUM
POTTHASTIA
PROBEZZIA
PROSIMULIUM
PROSTOIA
PSEPHENUS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIALIS
SIMULIIDAE
SIMULIUM
SPHAERIIDAE
SPHAERIUM
STEGOPTERNA
STENACRON
STENELMIS
STENONEMA
STILOBEZZIA
SUBLETTEA
SYMPOSIOCLADIUS
SYMPOTTHASTIA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
PROCLOEON
STYLOGOMPHUS
TRIBELOS
ANCYRONYX
TRISSOPELOPIA
TUBIFICIDAE
PARALAUTERBORNIELLA
XYLOTOPUS
PROCLADIUS
TVETENIA
DINEUTUS
GYRINUS
ZAVRELIMYIA

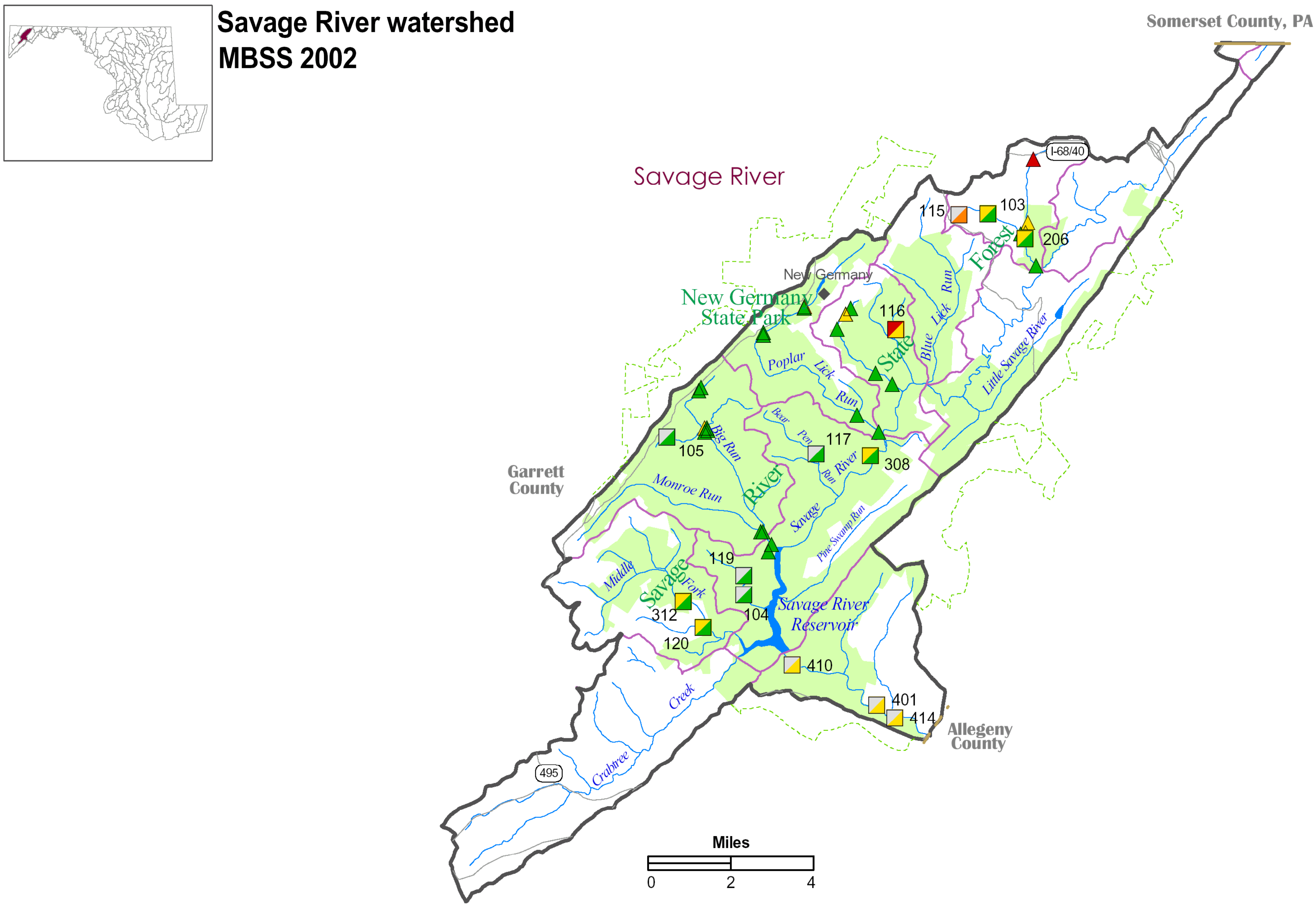
Rocky Gorge Dam

Herpetofauna Present

AMERICAN TOAD
COMMON SNAPPING TURTLE
EASTERN BOX TURTLE
GREEN FROG
NORTHERN DUSKY SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
RED SALAMANDER
WOOD FROG

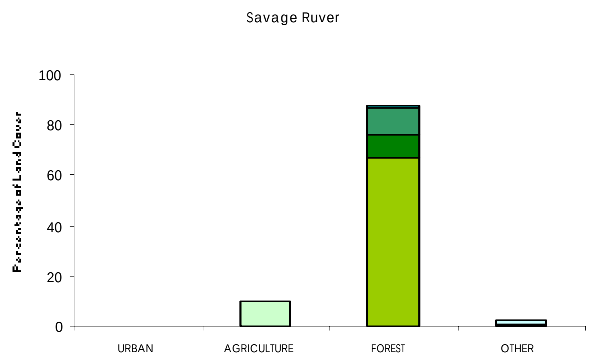
Stream Waders Data

No Stream Waders Data for 2002



Savage River watershed
MBSS 2002
Somerset County, PA
Savage River
I-68/40
115
103
206
New Germany
New Germany State Park
116
Forest
State
Run
Lick
Blue
Little Savage River
Poplar
Lick
Run
Bear
Pen
Run
117
308
River
105
Big Run
Garrett County
Monroe Run
River
Savage
Pine Swamp Run
119
Middle
Savage
Fork
312
104
Savage River Reservoir
120
410
401
414
Allegeny County
Creek
495
Crabtree
Miles
0
2
4

Savage River



Savage River

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
SAVA-103-R-2002	Christley Run	021410060083	Savage River	North Branch Potomac River	Garrett	2-Apr-02	23-Jul-02	1	676
SAVA-104-R-2002	Dry Run	021410060077	Savage River	North Branch Potomac River	Garrett	28-Mar-02	11-Jul-02	1	952
SAVA-105-R-2002	Big Run Whiskey Hollow Ut	021410060078	Savage River	North Branch Potomac River	Garrett	28-Mar-02	23-Jul-02	1	318
SAVA-115-R-2002	Christley Run	021410060083	Savage River	North Branch Potomac River	Garrett	2-Apr-02	23-Jul-02	1	84
SAVA-116-R-2002	Blacklick Run	021410060080	Savage River	North Branch Potomac River	Garrett	1-Apr-02	31-Jul-02	1	315
SAVA-117-R-2002	Bear Pen Run	021410060077	Savage River	North Branch Potomac River	Garrett	28-Mar-02	18-Jul-02	1	1252
SAVA-119-R-2002	Dry Run	021410060077	Savage River	North Branch Potomac River	Garrett	1-Apr-02	22-Jul-02	1	683
SAVA-120-R-2002	Tom'S Spring Run	021410060076	Savage River	North Branch Potomac River	Garrett	2-Apr-02	22-Jul-02	1	965
SAVA-206-R-2002	Mudlick Run	021410060083	Savage River	North Branch Potomac River	Garrett	2-Apr-02	24-Jul-02	2	3269
SAVA-308-R-2002	Savage R	021410060077	Savage River	North Branch Potomac River	Garrett	28-Mar-02	17-Jul-02	3	30422
SAVA-312-R-2002	Middle Fork Run	021410060076	Savage River	North Branch Potomac River	Garrett	1-Apr-02	22-Jul-02	3	4713
SAVA-401-R-2002	Savage R	021410060075	Savage River	North Branch Potomac River	Garrett	10-Apr-02	6-Jun-02	4	70624
SAVA-410-R-2002	Savage R	021410060075	Savage River	North Branch Potomac River	Garrett	10-Apr-02	5-Aug-02	4	67371
SAVA-414-R-2002	Savage R	021410060075	Savage River	North Branch Potomac River	Garrett	10-Apr-02	6-Jun-02	4	73031

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
SAVA-103-R-2002	3.00	4.33	58.46	0	1
SAVA-104-R-2002	NR	4.56	88.50	0	1
SAVA-105-R-2002	NR	4.56	98.14	0	1
SAVA-115-R-2002	NS	2.33	NS	NS	NS
SAVA-116-R-2002	1.00	3.67	15.65	0	0
SAVA-117-R-2002	NR	4.33	58.46	0	1
SAVA-119-R-2002	NR	4.11	24.00	0	1
SAVA-120-R-2002	3.00	4.33	47.80	0	1
SAVA-206-R-2002	3.00	4.33	76.88	0	1
SAVA-308-R-2002	3.86	4.56	78.99	0	1
SAVA-312-R-2002	3.57	4.56	52.91	0	1
SAVA-401-R-2002	NR	3.89	92.20	0	1
SAVA-410-R-2002	NR	3.89	92.91	0	1
SAVA-414-R-2002	NR	3.44	86.96	0	1

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious
SAVA-103-R-2002	0.53	55.43	43.72	0.33	0.13
SAVA-104-R-2002	0.05	4.83	83.82	11.30	0.01
SAVA-105-R-2002	0.00	1.54	98.46	0.00	0.00
SAVA-115-R-2002	0.79	55.94	43.27	0.00	0.20
SAVA-116-R-2002	0.00	7.68	91.68	0.63	0.00
SAVA-117-R-2002	0.00	6.29	72.86	20.85	0.00
SAVA-119-R-2002	0.07	6.25	79.81	13.87	0.02
SAVA-120-R-2002	0.07	8.36	91.55	0.02	0.02
SAVA-206-R-2002	0.31	43.80	55.37	0.52	0.15
SAVA-308-R-2002	0.25	16.05	83.00	0.70	0.12
SAVA-312-R-2002	0.02	10.40	88.59	0.99	0.00
SAVA-401-R-2002	0.48	30.07	63.33	6.13	0.20
SAVA-410-R-2002	0.17	10.57	87.10	2.16	0.07
SAVA-414-R-2002	0.17	10.39	87.25	2.19	0.07

Savage River

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (μeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
SAVA-103-R-2002	6.75	82.2	151.4	3.895	2.204	11.937	0.0266	0.0087	0.0029	0.0106	2.2436	1.2084	9.1	4.2
SAVA-104-R-2202	6.80	69.2	116.7	1.652	1.308	14.785	0.0135	0.0086	0.0005	0.0028	1.3625	1.0058	9.7	5.4
SAVA-105-R-2002	6.87	48.4	57.0	3.260	0.604	8.682	0.0052	0.0007	0.0004	0.0020	0.6409	0.7105	9.5	1.6
SAVA-115-R-2002	6.32	99.1	131.4	4.760	3.815	12.552	0.0273	0.0138	0.0011	0.0045	3.8334	0.9172	NS	NS
SAVA-116-R-2002	6.86	51.3	58.9	1.072	0.642	11.913	0.0152	0.0060	0.0004	0.0020	0.6903	1.3774	9.7	8
SAVA-117-R-2002	6.55	52.8	78.4	1.173	0.600	13.120	0.0144	0.0112	0.0004	0.0026	0.6557	0.9219	8.4	1.9
SAVA-119-R-2002	7.18	69.7	138.5	1.907	1.169	13.129	0.0124	0.0063	0.0004	0.0021	1.2227	1.0666	6.6	1.5
SAVA-120-R-2002	7.02	55.0	787.0	1.010	0.792	13.169	0.0073	0.0058	0.0004	0.0041	0.8246	0.7950	9.2	1.4
SAVA-206-R-2002	7.14	145.5	132.9	26.906	1.278	9.586	0.0109	0.0007	0.0014	0.0059	1.3805	1.5519	8.6	2.9
SAVA-308-R-2002	7.26	97.5	164.6	12.761	0.749	11.632	0.0093	0.0026	0.0014	0.0060	0.8234	1.4237	NS	NS
SAVA-312-R-2002	7.02	72.8	88.1	4.239	0.919	13.399	0.0089	0.0034	0.0004	0.0030	0.9869	1.2994	8.4	0.9
SAVA-401-R-2002	7.39	106.4	206.9	12.650	0.880	13.051	0.0106	0.0007	0.0016	0.0042	0.9500	1.5230	10.9	1.5
SAVA-410-R-2002	7.35	106.3	202.7	13.090	0.869	12.744	0.0107	0.0026	0.0031	0.0093	0.9654	1.5579	12.8	1.8
SAVA-414-R-2002	7.38	106.9	210.5	12.632	0.870	13.124	0.0094	0.0007	0.0018	0.0048	0.9561	1.4626	10.9	1.5

Physical Habitat Condition

Site	Riparia	Riparian	Adjacent	Adjacent	Instream	Epifaunal	Velocity/	Pool/	Extent of	Riffle/	Extent of	Embedd-	Shading	Trash	Maximum
SAVA-103-R-2002	50	50	FR	FR	16	12	13	14	52	9	25	30	95	17	58
SAVA-104-R-2002	45	50	PV	FR	17	19	13	17	28	18	60	15	85	15	62
SAVA-105-R-2002	50	50	FR	FR	16	13	10	10	25	14	65	35	92	20	32
SAVA-115-R-2002	50	50	FR	HO	NS	NS	NS	NS	NS	NS	NS	NS	NS	16	NS
SAVA-116-R-2002	50	50	FR	FR	8	15	5	4	25	7	55	25	95	20	16
SAVA-117-R-2002	50	50	FR	FR	14	12	8	10	19	8	56	20	92	20	38
SAVA-119-R-2002	50	50	FR	FR	11	18	7	10	25	6	37	15	92	18	26
SAVA-120-R-2002	50	50	FR	FR	15	17	8	7	33	12	45	15	95	20	24
SAVA-206-R-2002	50	50	FR	FR	14	12	10	13	46	10	35	20	95	20	70
SAVA-308-R-2002	50	50	FR	FR	17	18	13	14	35	18	52	20	35	17	61
SAVA-312-R-2002	50	50	FR	FR	14	18	8	5	35	15	55	15	90	19	18
SAVA-401-R-2002	50	50	FR	FR	19	18	18	17	70	20	75	20	80	18	80
SAVA-410-R-2002	50	50	FR	FR	20	17	19	18	75	19	65	25	60	19	121
SAVA-414-R-2002	50	50	FR	FR	18	18	16	15	70	19	75	20	70	16	54

Savage River

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
SAVA-103-R-2002	N	N	N	N	Mild	Mild	Moderate
SAVA-104-R-2002	Y	N	N	N	Moderate	Moderate	None
SAVA-105-R-2002	N	N	N	N	None	None	Mild
SAVA-115-R-2002	N	N	N	N	NS	NS	NS
SAVA-116-R-2002	N	N	N	N	Mild	Mild	Mild
SAVA-117-R-2002	N	N	N	N	None	None	Mild
SAVA-119-R-2002	N	N	N	N	None	None	Mild
SAVA-120-R-2002	N	N	N	N	Mild	Mild	Mild
SAVA-206-R-2002	N	N	N	N	None	None	Moderate
SAVA-308-R-2002	N	N	N	N	Mild	None	Moderate
SAVA-312-R-2002	N	N	N	N	None	Moderate	None
SAVA-401-R-2002	N	N	N	N	None	None	Moderate
SAVA-410-R-2002	N	N	N	N	None	None	Mild
SAVA-414-R-2002	N	N	N	N	None	None	Moderate

Interpretation of Watershed Condition

- Watershed generally highly forested
- ANC values low at some sites
- Nitrogen and phosphorus values low at some sites
- Physical habitat condition generally good

Savage River

Fish Species Present

BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BROOK TROUT
BROWN TROUT
CENTRAL STONEROLLER
COMMON SHINER
CREEK CHUB
CUTLIPS MINNOW
FALLFISH
FANTAIL DARTER
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
POTOMAC SCULPIN
PUMPKINSEED
RAINBOW TROUT
RIVER CHUB
ROCK BASS
ROSYSIDE DACE
WHITE SUCKER
YELLOW PERCH

Exotic Plants Present

MICROSTEGIUM
MULTIFLORA ROSE

Benthic Taxa Present

ACENTRELLA
ACERPENNA
ACRONEURIA
ALLOPERLA
AMELETUS
AMPHINEMURA
ANTOCHA
BAETIDAE
BAETIS
BRILLIA
CAECIDOTEA
CAMBARIDAE
CHAETOCLADIUS
CHELIFERA
CHEUMATOPSYCHE
CHIRONOMIDAE
CHIRONOMINAE
CHIRONOMINI
CHLOROPERLIDAE
CINYGMULA
CLINOCERA
CONCHAPELOPIA
DIAMESA
DICRANOTA
DICROTENDIPES
DIPHETOR
DIPLECTRONA
DIPTERA
DOLOPHILODES
DRUNELLA
DUGESIA
ELMIDAE
EPEORUS
EPHEMERA
EPHEMERELLA
EPHEMERELLIDAE
ERIOPTERA
EUKIEFFERIELLA
EURYLOPHELLA
FALLCEON
GAMMARUS
HEPTAGENIIDAE
HETEROTRISSOCLADIUS
HEXATOMA
HYDROPSYCHE
HYDROPSYCHIDAE
HYDROPTILA
IRONOQUIA
ISONYCHIA
ISOPERLA
ISOTOMIDAE
LANTHUS
LEPIDOSTOMA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEUCROCUTA
LEUCTRA
LEUCTRIDAE
LIMNEPHILIDAE
LUMBRICULIDAE
LYMNAEIDAE
MICROPSECTRA
MICROTENDIPES
MOLOPHILUS
NAIDIDAE
NANOCLADIUS
NEMOURA
NEMOURIDAE
NEOPHYLAX
OEMOPTERYX
OLIGOCHAETA
ORMOSIA
ORTHOCLADIINAE
ORTHOCLADIUS
OULIMNIUS
PARACAPNIA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PELTOPERLA
PERLIDAE
PERLODIDAE
PHAGOCATA
PLANARIIDAE
POLYCENTROPODIDAE
POLYPEDILUM
POTTHASTIA
PROBEZZIA
PROSIMULIUM
PROSTOMA
PSEPHENUS
PTERONARCYS
RHEOCRICOTOPUS
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIMULIIDAE
SPHAERIIDAE
STEGOPTERNA
STEMPELLINA
STENACRON
STENONEMA
SWELTSA
TALLAPERLA
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRIBELOS
TUBIFICIDAE
TVETENIA
WORMALDIA

Herpetofauna Present

GREEN FROG
MOUNTAIN DUSKY SALAMANDER
NORTHERN DUSKY SALAMANDER
NORTHERN SPRING SALAMANDER
NORTHERN TWO-LINED SALAMANDER

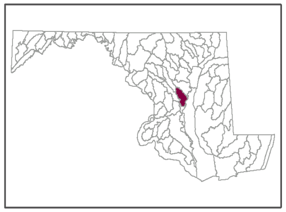
Savage River

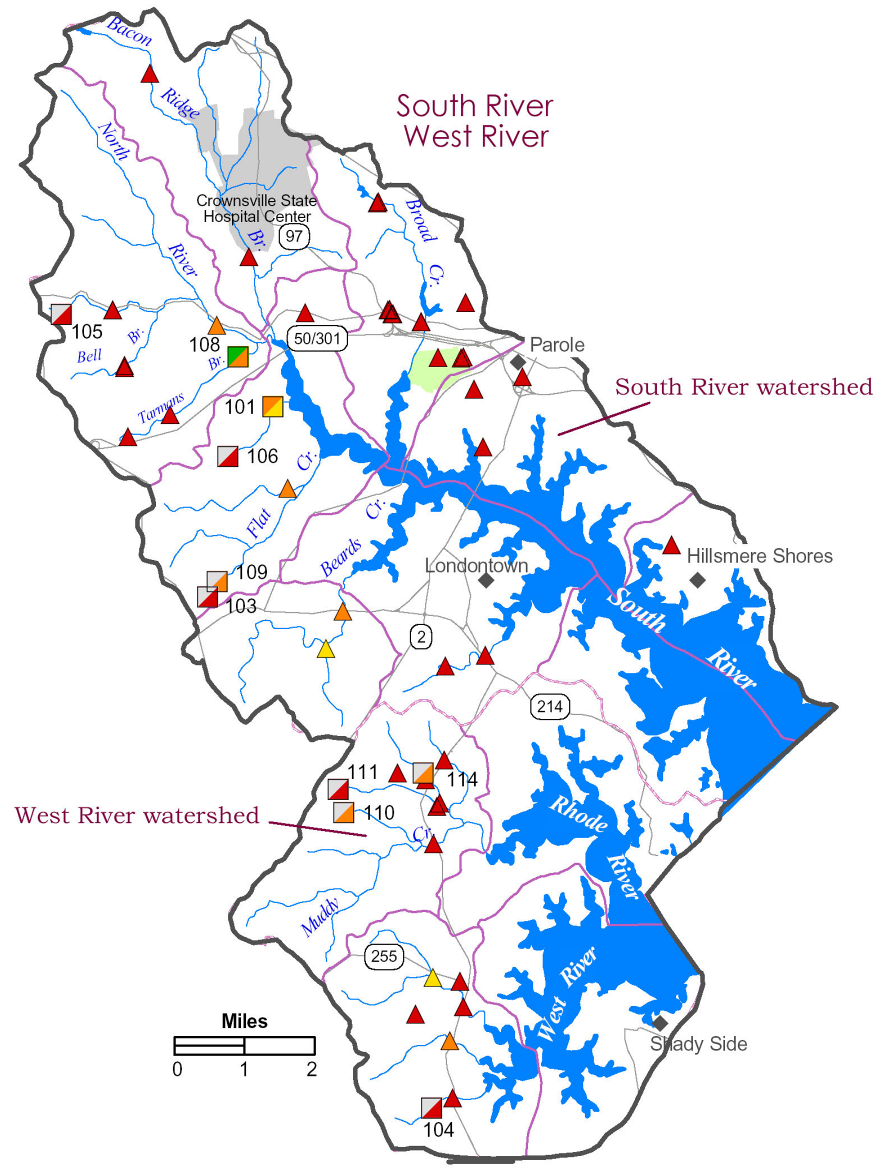
Stream Waders Data

Site	8-Digit Watershed	Stream Name	Benthic IBI
77-5	Savage River	Big Run	4.71
77-95	Savage River	Big Run	4.14
78-1	Savage River	Big Run	4.14
78-2	Savage River	Miller Run	5.00
78-3	Savage River	Whiskey Hollow	5.00
78-4	Savage River	Monroe Run	4.71
78-91	Savage River	Big Run	4.14
78-92	Savage River	Miller Run	3.86
78-93	Savage River	Whiskey Hollow	4.71
78-94	Savage River	Monroe Run	4.43
79-1	Savage River	Poplar Lick	2.14
79-2	Savage River	Poplar Lick Run	4.71
79-3	Savage River	Poplar Lick	5.00
79-4	Savage River	UN trib to Poplar Lick	4.43
79-91	Savage River	Poplar Lick Run	4.14
79-92	Savage River	Poplar Lick Run	4.43
80-1	Savage River	Elk Lick North Branch	4.43
80-2	Savage River	UT	3.86
80-3	Savage River	Elk Lick	4.71
80-4	Savage River	Elk Lick UT	4.71
80-5	Savage River	Elk Lick	4.14
80-92	Savage River	Elk Lick UT	4.14
83-1	Savage River	Mudlick Run	4.14
83-2	Savage River	Mudlick Run	1.86
83-3	Savage River	Mudlick Run UT	3.57
83-4	Savage River	Christley Run	4.43
83-5	Savage River	Mudlick Run	3.57

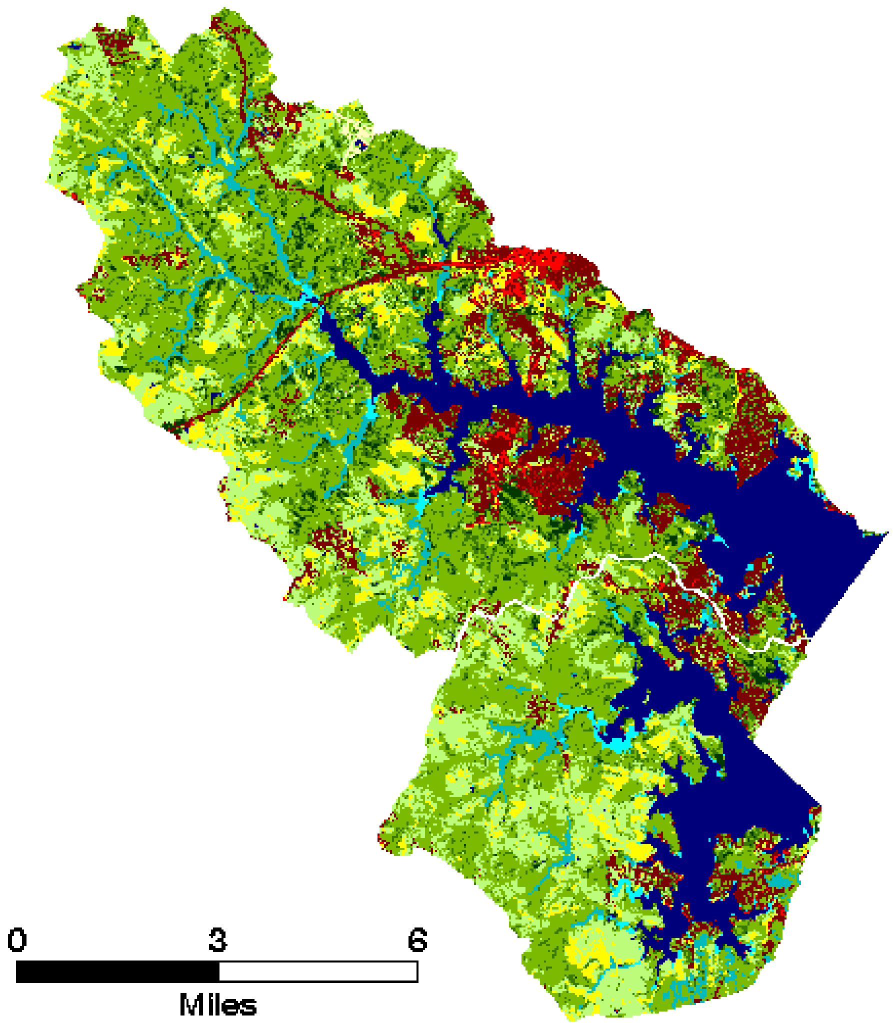
Savage River

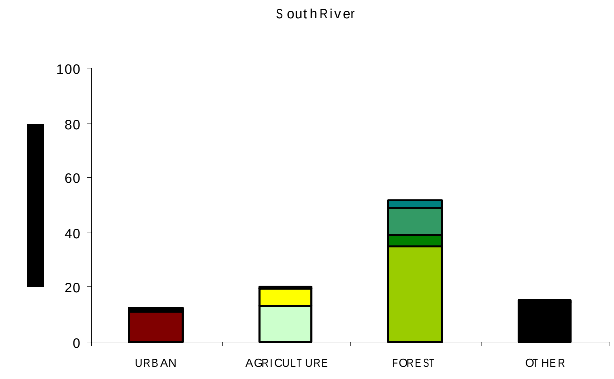
South River/ West River watersheds MBSS 2002

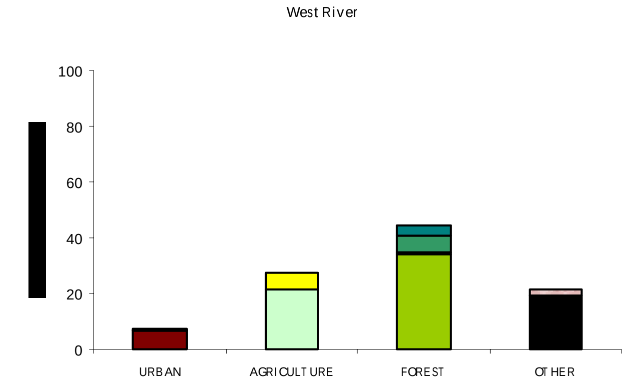




South River/West River







South River/West River

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
SOUT-101-R-2002	South R Ut 1	021310030992	South River	West Chesapeake Bay	Anne Arundel	11-Mar-02	3-Jun-02	1	658
SOUT-103-R-2002	Flat Cr	021310030992	South River	West Chesapeake Bay	Anne Arundel	12-Mar-02	4-Jun-02	1	69
SOUT-105-R-2002	Bell Br Ut 1	021310030994	South River	West Chesapeake Bay	Anne Arundel	11-Mar-02	3-Jun-02	1	68
SOUT-106-R-2002	South R Ut 1	021310030992	South River	West Chesapeake Bay	Anne Arundel	11-Mar-02	3-Jun-02	1	84
SOUT-108-R-2002	Tarnans Br	021310030994	South River	West Chesapeake Bay	Anne Arundel	11-Mar-02	23-Jul-02	1	1393
SOUT-109-R-2002	Flat Cr	021310030992	South River	West Chesapeake Bay	Anne Arundel	12-Mar-02	4-Jun-02	1	216
WEST-104-R-2002	Johns Cr Ut	021310040983	West River	West Chesapeake Bay	Anne Arundel	12-Mar-02	17-Jun-02	1	240
WEST-110-R-2002	Mill Swamp Br	021310040985	West River	West Chesapeake Bay	Anne Arundel	12-Mar-02	4-Jun-02	1	74
WEST-111-R-2002	Williamson Br	021310040985	West River	West Chesapeake Bay	Anne Arundel	12-Mar-02	17-Jun-02	1	67
WEST-114-R-2002	Bluejay Br	021310040985	West River	West Chesapeake Bay	Anne Arundel	12-Mar-02	4-Jun-02	1	359

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
SOUT-101-R-2002	5.18	12.25	80.10	2.47	1.84
SOUT-103-R-2002	13.59	65.70	19.42	1.29	3.40
SOUT-105-R-2002	26.62	5.84	67.53	0.00	9.42
SOUT-106-R-2002	14.81	25.13	60.05	0.00	3.84
SOUT-108-R-2002	6.74	37.32	53.82	2.12	4.81
SOUT-109-R-2002	5.57	59.44	34.57	0.41	1.44
WEST-104-R-2002	0.46	45.32	54.12	0.09	0.12
WEST-110-R-2002	0.31	97.25	2.45	0.00	0.08
WEST-111-R-2002	3.62	63.49	32.89	0.00	1.07
WEST-114-R-2002	6.38	49.97	43.10	0.56	1.63

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
SOUT-101-R-2002	2.00	3.00	12.07	0	0
SOUT-103-R-2002	NR	1.86	6.10	0	0
SOUT-105-R-2002	NR	1.57	32.51	0	0
SOUT-106-R-2002	NR	1.86	8.89	0	0
SOUT-108-R-2002	5.00	2.43	52.94	0	0
SOUT-109-R-2002	NR	2.71	68.54	0	0
WEST-104-R-2002	NR	1.86	7.96	0	0
WEST-110-R-2002	NR	2.71	4.36	0	0
WEST-111-R-2002	NR	1.57	11.50	0	0
WEST-114-R-2002	NS	2.43	NS	NS	NS

Interpretation of Watershed Condition

- Site 110 located in a highly agricultural catchment
- ANC values low throughout
- Chloride, phosphorus, and ammonia values elevated at most sites
- Turbidity high at most sites
- Physical habitat condition generally poor

South River/West River

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
SOUT-101-R-2002	6.43	224.0	139.7	53.861	0.671	3.164	0.0144	0.0007	0.0047	0.1549	0.8707	0.7718	8.8	3.6
SOUT-103-R-2002	5.79	271.3	58.4	49.909	0.867	27.947	0.0552	0.0007	0.0095	0.0665	0.9879	1.8255	6.8	6.8
SOUT-105-R-2002	5.47	248.3	-98.2	57.110	0.179	13.650	0.1055	0.0007	0.0050	0.0480	0.2834	0.7557	7.2	12.7
SOUT-106-R-2002	5.79	340.7	197.9	79.158	0.815	4.826	0.1636	0.0007	0.0039	0.0447	0.8709	0.5830	3.5	10.6
SOUT-108-R-2002	6.10	236.8	51.7	53.158	0.127	12.450	0.0266	0.0007	0.0021	0.0297	0.2185	1.5360	4.9	23.9
SOUT-109-R-2002	6.02	343.4	100.4	72.488	0.490	24.865	0.0859	0.0007	0.0072	0.0834	0.6286	1.8515	4.5	9.6
WEST-104-R-2002	6.75	192.8	209.3	22.427	0.164	36.622	0.0680	0.0195	0.0048	0.0225	0.2840	2.9152	4.6	12.8
WEST-110-R-2002	6.98	107.7	427.9	6.252	0.332	12.622	0.1948	0.0197	0.0092	0.2449	0.8543	2.9849	7.6	49.1
WEST-111-R-2002	7.09	241.0	695.6	31.398	0.519	22.487	0.1134	0.0091	0.0161	0.1556	0.8092	3.3076	7.6	43
WEST-114-R-2002	6.55	210.3	220.5	29.370	0.149	33.787	0.0369	0.0061	0.0043	0.0188	0.2628	2.6732	NS	NS

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
SOUT-101-R-2002	50	50	FR	FR	7	11	6	7	40	11	40	100	95	12	20
SOUT-103-R-2002	50	0	FR	PA	3	3	2	2	53	6	22	55	90	16	17
SOUT-105-R-2002	50	50	FR	FR	4	5	11	11	38	13	37	100	96	13	69
SOUT-106-R-2002	50	35	FR	PV	3	3	6	6	64	11	11	75	92	10	24
SOUT-108-R-2002	50	50	FR	FR	9	8	11	12	60	15	17	100	77	18	61
SOUT-109-R-2002	50	50	FR	FR	6	9	10	14	50	11	25	55	95	17	101
WEST-104-R-2002	10	50	CP	FR	6	4	4	5	70	5	5	100	94	14	18
WEST-110-R-2002	0	0	PA	PA	2	2	4	3	44	6	31	100	20	15	15
WEST-111-R-2002	50	50	FR	FR	7	5	5	6	48	7	28	100	96	13	30
WEST-114-R-2002	40	50	HO	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	15	NS

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
SOUT-101-R-2002	N	N	N	N	Mild	Mild	Mild
SOUT-103-R-2002	Y	N	N	N	Moderate	Moderate	Mild
SOUT-105-R-2002	Y	N	N	N	Mild	Mild	Moderate
SOUT-106-R-2002	Y	N	N	N	Moderate	Moderate	Severe
SOUT-108-R-2002	N	N	N	N	Mild	Mild	Mild
SOUT-109-R-2002	N	N	N	N	Severe	Severe	Severe
WEST-104-R-2002	N	N	N	N	Mild	Mild	Mild
WEST-110-R-2002	Y	N	N	N	Moderate	Moderate	Mild
WEST-111-R-2002	N	N	N	N	Moderate	Moderate	Severe
WEST-114-R-2002	N	N	N	N	NS	NS	NS

South River/West River

Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUEGILL
BLUESPOTTED SUNFISH
CREEK CHUBSUCKER
EASTERN MUDMINNOW
FALLFISH
GOLDEN SHINER
GREEN SUNFISH
LEAST BROOK LAMPREY
REDFIN PICKEREL
ROSYSIDE DACE
TESSELLATED DARTER
WARMOUTH

Exotic Plants Present

JAPANESE HONEYSUCKLE
MICROSTEGIUM
MILE-A-MINUTE
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
AESHNIDAE
ANCHYTARSUS
ANCYRONYX
BITTACOMORPHA
BOYERIA
CAECIDOTEA
CALOPTERYX
CAPNIIDAE
CERATOPOGON
CERATOPOGONIDAE
CHAETOCLADIUS
CHEUMATOPSYCHE
CHIRONOMINI
CHIRONOMUS
CHRYSOGASTER
CHRYSOPS
CONCHAPELOPIA
CORDULEGASTER
CORIXIDAE
CORYNONEURA
CRANGONYCTIDAE
CRANGONYX
CRICOTOPUS
CRYPTOCHIRONOMUS
CULICOIDES
CYPHON
DICRANOTA
DICROTENDIPES
DIPLECTRONA
DIPLOCLADIUS
DIPTERA
DUGESIA
ENCHYTRAEIDAE
GAMMARUS
GERRIS
GORDIIDAE
HEMERODROMIA
HETEROPLECTRON
HETEROTRISSOCLADIUS
HEXATOMA
HYALELLA
HYDROBAENUS
HYDROBIUS
HYDROPORUS
HYDROPSYCHE
IRONOQUIA
ISCHNURA
ISOTOMURUS
LEUCTRIDAE
LIMNEPHILIDAE
LIMNODRILUS
LIMNOPHYES
LIOGMA
LUMBRICULIDAE
MEROPELOPIA
MICROPSECTRA
MICROTENDIPES
MICROVELIA
NATARSIA
NEMOURIDAE
NIGRONIA
NOTONECTA
ODONTOMESA
ORMOSIA
ORTHOCLADIINAE
ORTHOCLADIUS
PARAMETRIOCNEMUS
PARAPHAENOCLADIUS
PARATENDIPES
PHAENOPSECTRA
PHAGOCATA
PHYSELLA
POLYCENTROPODIDAE
POLYCENTROPUS
POLYPEDILUM
PROBEZZIA
PROCLADIUS
PRODIAMESA
PSEUDOLIMNOPHILA
PSEUDORTHOCLADIUS
PSEUDOSUCCINEA
PTILOSTOMIS
PYCNOPSYCHE
RHEOCRICOTOPUS
RHEOTANYTARSUS
SIALIS
SIMULIUM
SPHAERIIDAE
SPHAERIUM
STEGOPTERNA
STEMPELLINELLA
STYGONECTES
SYMPOSIOCLADIUS
SYMPOTTHASTIA
SYNURELLA
TABANIDAE
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIELLA
THIENEMANNIMYIA GROUP
TIPULA
TIPULIDAE
TRISSOPELOPIA
TUBIFICIDAE
TVETENIA
XYLOTOPUS
ZAVRELIMYIA

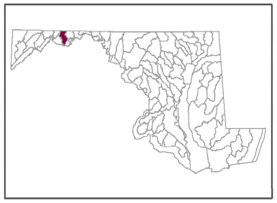
Herpetofauna Present

AMERICAN TOAD
BULLFROG
FOWLER’S TOAD
GREEN FROG
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
PICKEREL FROG
QUEEN SNAKE

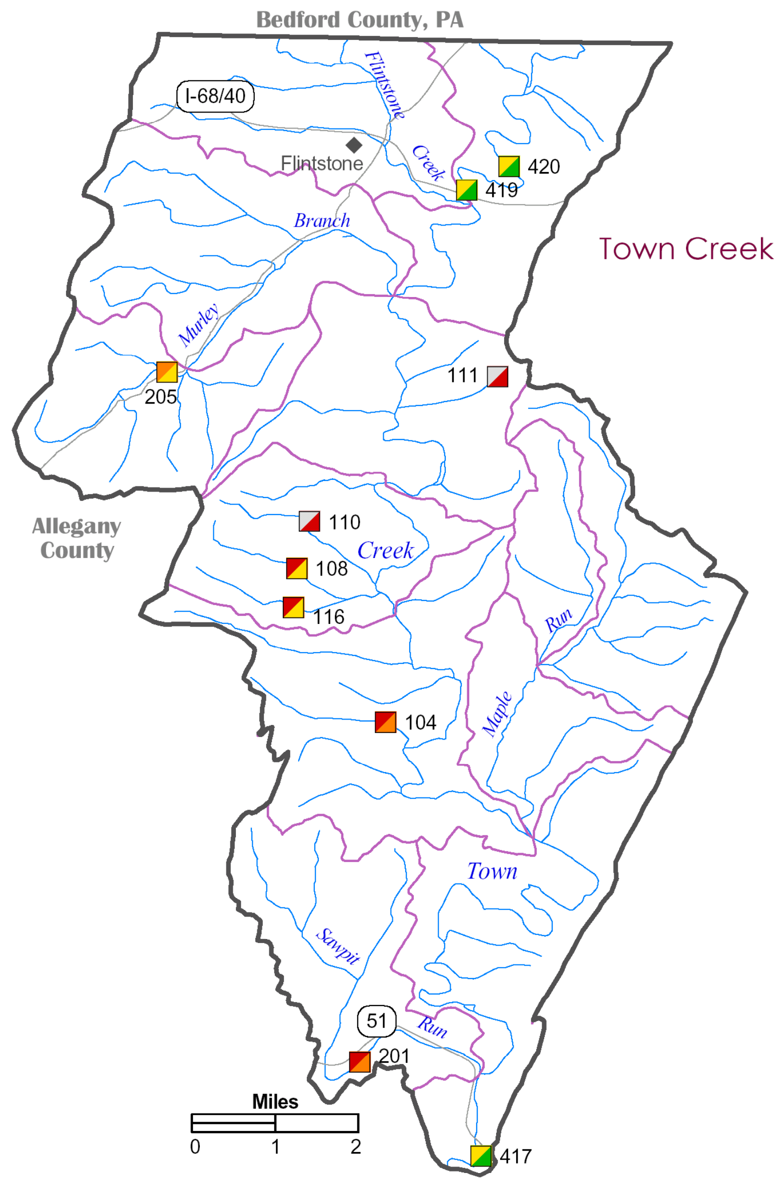
South River/West River

Stream Waders Data

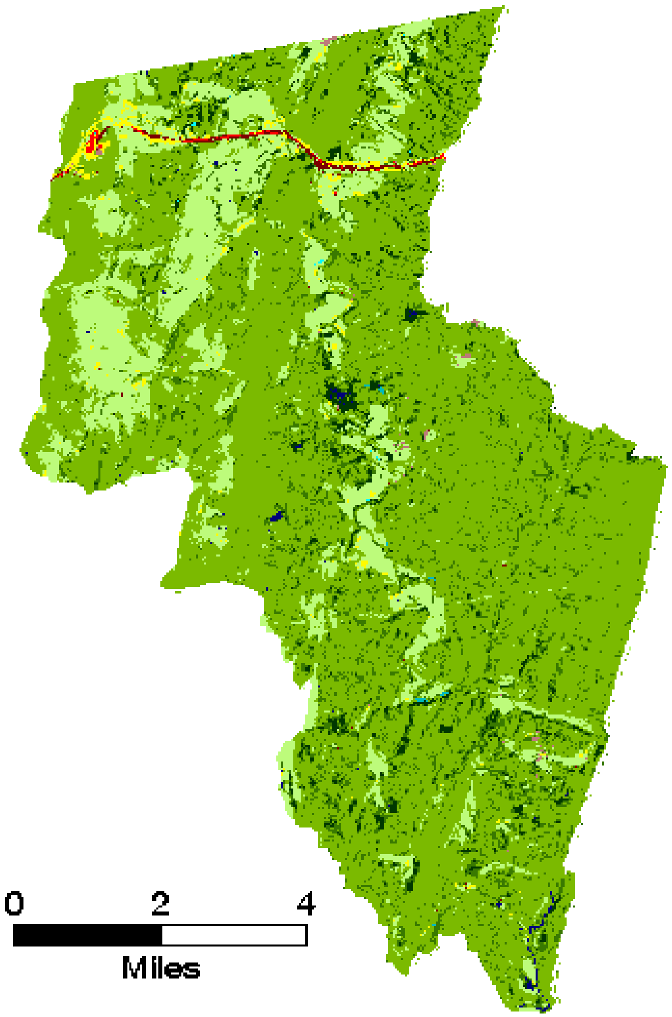
Site	8-Digit Watershed	Stream Name	Benthic IBI
993-3	South River	Broad Creek UT	1.86
993-4	South River	Broad Creek UT	1.29
993-5	South River	Broad Creek UT	1.57
993-95	South River	Broad Creek UT	1.29
987-1	South River	Beard Creek UT	3.00
987-2	South River	Beard Creek UT	2.14
988-1	South River	Glebe Branch	1.29
988-2	South River	Glebe Branch	1.57
990-1	South River	Harness Creek	1.29
991-5	South River	Church Creek	1.57
991-6	South River	Gingerville Creek	1.29
991-7	South River	Gingerville Creek UT	1.57
992-1	South River	Flat Creek UT	2.14
992-2	South River	Bacon Ridge Branch UT to UT	1.57
993-1	South River	Broad Creek UT	1.29
993-2	South River	Broad Creek	1.86
993-6	South River	Broad Creek UT	1.57
993-7	South River	S. Basin UT	1.29
993-91	South River	Broad Creek UT	1.57
993-92	South River	Broad Creek UT	1.00
993-93	South River	Broad Creek UT	1.29
993-94	South River	Broad Creek UT	1.29
994-1	South River	Bell Branch UT	2.14
994-2	South River	Bell Branch	1.86
994-3	South River	Tarnans Branch	1.57
994-4	South River	Tarnans Branch	1.57
994-5	South River	North River	2.71
994-91	South River	Bell Branch UT	1.57
994-92	South River	Bell Branch	1.29
995-1	South River	Bacon Ridge Branch	1.86
995-4	South River	Bacon Ridge Branch	1.86
983-1	West River	Lerch Creek UT	1.86
983-2	West River	Lerch Creek	3.00
983-3	West River	Lerch Creek	1.57
983-4	West River	Smith Creek UT	1.57
983-5	West River	Smith Creek	2.71
983-6	West River	Johns Creek	1.86
985-1	West River	Blue Jay Branch	1.57
985-2	West River	Williamson Branch	1.86
985-3	West River	Jessica Brook	1.57
985-4	West River	Blue Jay Branch	1.86
985-5	West River	Big Hob Run	1.86
985-6	West River	North Fork Muddy Creek	1.57



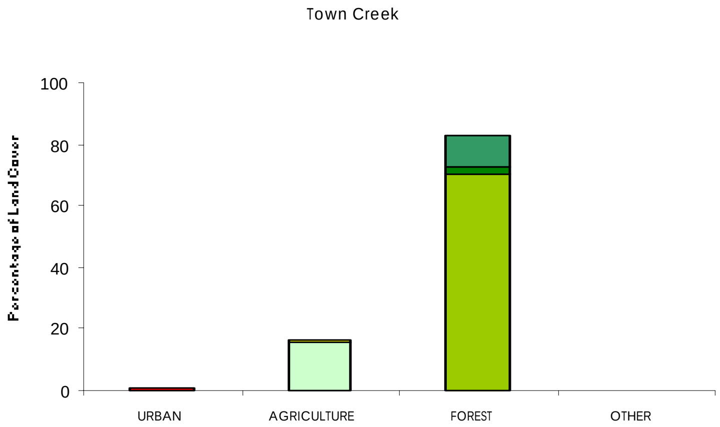
Town Creek watershed
MBSS 2002



Town Creek



0
2
4
Miles



Town Creek
Percentage of Land Cover
100
80
60
40
20
0
URBAN
AGRICULTURE
FOREST
OTHER

Town Creek

Site Information

Site	Stream Name	12-Digit Subwatershed Code	8-digit Watershed	Basin	County	Date Sampled Spring	Date Sampled Summer	Order	Catchment Area (acres)
TOWN-104-R-2002	Sugar Hollow Run	021405120124	Town Creek	Upper Potomac River	Allegany	26-Mar-02	1-Jul-02	1	703
TOWN-108-R-2002	Bear Hollow	021405120128	Town Creek	Upper Potomac River	Allegany	26-Mar-02	10-Jul-02	1	526
TOWN-110-R-2002	Burnt House Hollow	021405120128	Town Creek	Upper Potomac River	Allegany	26-Mar-02	10-Jul-02	1	133
TOWN-111-R-2002	Town Cr Ut 2	021405120129	Town Creek	Upper Potomac River	Allegany	26-Mar-02	13-Jun-02	1	55
TOWN-116-R-2002	Lick Run	021405120128	Town Creek	Upper Potomac River	Allegany	26-Mar-02	10-Jul-02	1	385
TOWN-201-R-2002	Saw Pit Run	021405120123	Town Creek	Upper Potomac River	Allegany	26-Mar-02	13-Jun-02	2	2813
TOWN-205-R-2002	Murley Br	021405120130	Town Creek	Upper Potomac River	Allegany	27-Mar-02	16-Jul-02	2	2041
TOWN-417-R-2002	Town Cr	021405120122	Town Creek	Upper Potomac River	Allegany	27-Mar-02	16-Jul-02	4	104835
TOWN-419-R-2002	Town Cr	021405120131	Town Creek	Upper Potomac River	Allegany	10-Apr-02	15-Jul-02	4	47166
TOWN-420-R-2002	Town Cr	021405120131	Town Creek	Upper Potomac River	Allegany	10-Apr-02	15-Jul-02	4	46656

Indicator Information

Site	FIBI	BIBI	PHI	Black Water Stream	Brook Trout Present
TOWN-104-R-2002	1.00	2.78	10.19	0	0
TOWN-108-R-2002	1.00	3.89	11.58	0	0
TOWN-110-R-2002	NS	1.67	NS	NS	NS
TOWN-111-R-2002	NS	1.44	NS	NS	NS
TOWN-116-R-2002	1.00	3.44	4.32	0	0
TOWN-201-R-2002	1.86	2.78	37.33	0	0
TOWN-205-R-2002	2.14	3.89	86.00	0	0
TOWN-417-R-2002	3.86	4.11	91.59	0	0
TOWN-419-R-2002	3.86	4.11	86.49	0	0
TOWN-420-R-2002	3.86	4.11	85.50	0	0

Catchment Land Use Information

Site	Percent Urban	Percent Agriculture	Percent Forest	Percent Other	Percent Impervious Surface
TOWN-104-R-2002	0.03	16.12	83.85	0.00	0.01
TOWN-108-R-2002	0.04	14.65	83.28	2.03	0.01
TOWN-110-R-2002	0.00	18.61	81.22	0.17	0.00
TOWN-111-R-2002	0.00	0.00	100.00	0.00	0.00
TOWN-116-R-2002	0.00	13.93	85.95	0.12	0.00
TOWN-201-R-2002	0.02	9.40	90.42	0.17	0.00
TOWN-205-R-2002	0.08	38.53	61.28	0.11	0.02
TOWN-417-R-2002	0.37	14.30	84.27	1.05	0.27
TOWN-419-R-2002	0.08	14.55	83.40	1.96	0.06
TOWN-420-R-2002	0.00	14.46	83.56	1.97	0.00

Interpretation of Watershed Condition

- Catchment areas are all highly forested
- ANC low at two sites
- Sulfate high at one site
- Physical habitat condition generally good

Town Creek

Water Chemistry Information

Site	Closed pH	Specific Cond	ANC (µeq/L)	Cl (mg/L)	Nitrate-N (mg/L)	SO4 (mg/L)	T-P (mg/L)	Ortho-P (mg/L)	Nitrite (mg/L)	Ammonia (mg/L)	T-N (mg/L)	DOC (mg/L)	DO (mg/L)	Turbidity (NTUs)
TOWN-104-R-2002	6.81	100.7	165.3	9.761	0.410	16.572	0.0044	0.0007	0.0006	0.0027	0.4615	1.6387	7.5	0.2
TOWN-108-R-2002	7.37	162.1	641.7	1.611	0.078	35.341	0.0079	0.0007	0.0004	0.0044	0.1846	2.6207	7.5	2.9
TOWN-110-R-2002	6.46	119.5	160.2	1.411	0.091	36.513	0.0100	0.0007	0.0010	0.0043	0.1356	1.6938	NS	NS
TOWN-111-R-2002	6.64	91.5	329.7	2.035	0.209	18.878	0.0193	0.0007	0.0005	0.0093	0.2655	1.9016	NS	NS
TOWN-116-R-2002	7.24	301.9	586.3	1.803	0.250	100.337	0.0050	0.0007	0.0004	0.0070	0.3248	2.0199	4.9	11.6
TOWN-201-R-2002	7.17	151.7	429.6	6.367	0.358	31.451	0.0077	0.0007	0.0022	0.0055	0.4575	2.3595	5.5	7.2
TOWN-205-R-2002	7.84	504.4	5334.2	5.038	1.635	26.014	0.0314	0.0049	0.0056	0.0187	1.7560	2.0534	9.9	2.8
TOWN-417-R-2002	7.51	146.3	689.2	7.978	0.532	17.396	0.0111	0.0007	0.0027	0.0042	0.6585	2.9871	7.8	2
TOWN-419-R-2002	7.67	104.7	504.5	5.191	0.202	13.711	0.0112	0.0007	0.0021	0.0041	0.2697	2.1935	7.7	2.9

Physical Habitat Condition

Site	Riparian Buffer Width Left	Riparian Buffer Width Right	Adjacent Cover Left	Adjacent Cover Right	Instream Habitat Structure	Epifaunal Substrate	Velocity/ Depth Diversity	Pool/ Glide/ Eddy Quality	Extent of Pools (m)	Riffle/ Run Quality	Extent of Riffles (m)	Embedd-edness (%)	Shading (%)	Trash Rating	Maximum Depth (cm)
TOWN-104-R-2002	50	50	FR	FR	8	12	5	6	22	6	8	25	90	20	20
TOWN-108-R-2002	50	50	FR	FR	9	15	5	4	31	6	44	20	96	19	17
TOWN-110-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
TOWN-111-R-2002	50	50	FR	FR	NS	NS	NS	NS	NS	NS	NS	NS	NS	20	NS
TOWN-116-R-2002	50	50	FR	FR	9	12	4	5	17	0	0	40	94	20	16
TOWN-201-R-2002	50	50	TG	FR	16	11	10	13	75	0	0	50	30	20	99
TOWN-205-R-2002	50	0	FR	PA	16	14	11	12	39	17	42	20	80	14	64
TOWN-417-R-2002	50	50	FR	FR	18	18	13	15	65	17	65	20	60	16	50
TOWN-419-R-2002	50	50	FR	FR	16	17	14	12	40	18	43	20	40	12	58
TOWN-420-R-2002	0	0	PA	CP	17	16	14	15	65	15	17	20	40	16	64

Physical Habitat Modifications

Site	Buffer Breaks?	Surface Mine?	Landfill?	Channelization?	Erosion Severity Left	Erosion Severity Right	Bar Formation
TOWN-104-R-2002	N	N	N	N	Mild	Mild	Mild
TOWN-108-R-2002	N	N	N	N	Moderate	Moderate	Mild
TOWN-110-R-2002	N	N	N	N	NS	NS	NS
TOWN-111-R-2002	N	N	N	N	NS	NS	NS
TOWN-116-R-2002	N	N	N	N	Mild	Mild	Mild
TOWN-201-R-2002	N	N	N	N	None	None	None
TOWN-205-R-2002	Y	N	N	Y	Moderate	Moderate	Mild
TOWN-417-R-2002	N	N	N	N	None	None	Mild
TOWN-419-R-2002	N	N	N	Y	Moderate	None	Mild
TOWN-420-R-2002	Y	N	N	N	None	Moderate	Moderate

Town Creek
Fish Species Present

AMERICAN EEL
BLACKNOSE DACE
BLUE RIDGE SCULPIN
BLUEGILL
BLUNTNOSE MINNOW
BROWN BULLHEAD
CENTRAL STONEROLLER
CHAIN PICKEREL
COMMON SHINER
CREEK CHUB
CREEK CHUBSUCKER
CUTLIPS MINNOW
CUTTHROAT TROUT
FALLFISH
FANTAIL DARTER
GREEN SUNFISH
GREENSIDE DARTER
LARGEMOUTH BASS
LONGEAR SUNFISH
LONGNOSE DACE
MARGINED MADTOM
NORTHERN HOGSUCKER
NOTROPIS SP.
POTOMAC SCULPIN
PUMPKINSEED
RAINBOW DARTER
RAINBOW TROUT
REDBREAST SUNFISH
RIVER CHUB
ROCK BASS
SHORTHEAD REDHORSE
SMALLMOUTH BASS
SPOTFIN SHINER
SPOTTAIL SHINER
TESSELLATED DARTER
WHITE SUCKER
YELLOW BULLHEAD

Exotic Plants Present

MICROSTEGIUM
MULTIFLORA ROSE
THISTLE

Benthic Taxa Present

ABLABESMYIA
ACERPENNA
ACRONEURIA
AESHNIDAE
ALLOPERLA
AMELETUS
AMPHINEMURA
ANTOCHA
ARGIA
BAETIDAE
BAETIS
BLEPHARICERA
CAECIDOTEA
CAENIS
CAMBARIDAE
CAPNIIDAE
CERATOPOGON
CERATOPOGONIDAE
CHELIFERA
CHEUMATOPSYCHE
CHIMARRA
CHIRONOMIDAE
CHIRONOMINAE
CHIRONOMINI
CHLOROPERLIDAE
CINYGMULA
CLINOCERA
COENAGRIONIDAE
CONCHAPELOPIA
CORYDALUS
CORYNONEURA
CRANGONYX
DASYHELEA
DICRANOTA
DICROTENDIPES
DINEUTUS
DIPHETOR
DIPLECTRONA
DIPTERA
DRUNELLA
DUBIRAPHIA
DUGESIA
ECTOPRIA
ELMIDAE
ENALLAGMA
ENCHYTRAEIDAE
EPEORUS
EPHEMERELLA
EPHEMERELLIDAE
EUKIEFFERIELLA
EURYLOPHELLA
FERRISSIA
GAMMARUS
GASTROPODA
GLOSSOSOMATIDAE
GOMPHIDAE
GYRAULUS
HELICHUS
HEMERODROMIA
HEPTAGENIIDAE
HETEROTRISSOCLADIUS
HEXATOMA
HYALELLA
HYDROBAENUS
ISONYCHIA
ISOPERLA
ISOTOMURUS
LANTHUS
LEPIDOSTOMA
LEPTOPHLEBIA
LEPTOPHLEBIIDAE
LEPTOXIS
LEUCROCUTA
LEUCTRA
LEUCTRIDAE
LIMNEPHILIDAE
LIMNEPHILUS
LUMBRICULIDAE
MACRONYCHUS
MENETUS
MEROPELOPIA
MICRASEMA
MICROCYLLOEPUS
MICROPSECTRA
MICROTENDIPES
MOLANNODES
MOLOPHILUS
NAIDIDAE
NANOCLADIUS
NEMOURIDAE
NEOPHYLAX
NEURECLIPSIS
NIGRONIA
ODONATA
OECETIS
OEMOPTERYX
OLIGOCHAETA
OPTIOSERVUS
ORMOSIA
ORTHOCLADIINAE
ORTHOCLADIUS
OSTROCERCA
PARACAPNIA
PARACHAETOCLADIUS
PARAKIEFFERIELLA
PARALEPTOPHLEBIA
PARAMETRIOCNEMUS
PARATANYTARSUS
PARATENDIPES
PELTODYTES
PERLIDAE
PERLODIDAE
PHILOPOTAMIDAE
PHYSELLA
PLATYSMITTIA
POLYCENTROPODIDAE
POLYCENTROPUS

Town Creek

Benthic Taxa Present (Con't)

POLYPEDILUM
POTTHASTIA
PROBEZZIA
PROCLADIUS
PRODIAMESA
PROMORESIA
PROSIMULIUM
PROSTOMA
PSEPHENUS
PSEUDOCHIRONOMUS
PSEUDOSUCCINEA
PTERONARCYS
PYCNOPSYCHE
RHEOTANYTARSUS
RHYACOPHILA
SERRATELLA
SIALIS
SIMULIUM
SIPHLONURUS
SPHAERIUM
SPIROSPERMA
STEGOPTERNA
STEMPELLINELLA
STENELMIS
STENOCHIRONOMUS
STENONEMA
STROPHOPTERYX
STYGONECTES
SWELTSA
TAENIOPTERYX
TANYPODINAE
TANYTARSINI
TANYTARSUS
THIENEMANNIMYIA GROUP
TIPULIDAE
TRIAENODES
TVETENIA
WORMALDIA
ZAVRELIMYIA

Herpetofauna Present

EASTERN BOX TURTLE
GREEN FROG
NORTHERN SPRING SALAMANDER
NORTHERN TWO-LINED SALAMANDER
NORTHERN WATER SNAKE
WOOD TURTLE

Stream Waders Data

No Stream Waders data for 2002

5 TEMPORAL CHANGES IN PARAMETER ESTIMATES FOR 8-DIGIT WATERSHEDS

As each round of statewide sampling by the MBSS (or the Survey) is conducted at regular intervals over time, temporal changes (trends) in the stream condition statewide and for individual 8-digit watersheds can be evaluated. Such monitoring data are necessary to assessing whether implementation of Total Maximum Daily Loadings (TMDLs) and other restoration measures are effective in achieving or maintaining water quality standards (or in effecting other improvements in stream quality). The MBSS also provides information on physical parameters that can be used to track changes in habitat conditions and link such changes to trends in water quality. While these comparisons may be useful, it is important to remember that methods were often different in the first round than in the second.

This chapter compares results for the third year of MBSS Round Two (2002) with data from Round One (1995-1997). Three of the 8-digit watersheds sampled in 2002 also had more than 10 spring samples in one or two years of MBSS Round One. Data from two or three years are insufficient to estimate trends, but can be used to assess differences. The mean fish and benthic IBI scores were estimated as well as the percentage of stream miles with fish or benthic IBI scoring less than 3 for each year, along with the 90% confidence intervals. The combined IBI was not employed in the interannual variability analysis because comparisons could have obscured real differences apparent in individual fish or benthic IBIs. In general, the mean IBI scores were stable over time within the range of variablitity observed around the mean IBI scores (Table 5-1).

The yearly estimated confidence intervals for percentage of stream miles with fish or benthic IBI scores less than 3 overlapped for all watersheds (Table 5-2).

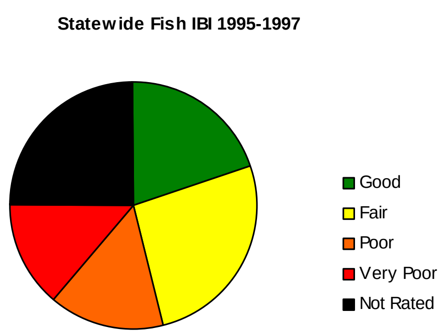
The detection of trends in mean IBI scores statewide, or for individual watersheds requires a time series of data. Although exact statistics can be obtained for ≥ 2 years, a minimum of four or more rounds of samples collected over time is required to obtain meaningful results using the non-parametric Mann-Kendall test for trends (Gilbert 1987, Hirsch et al. 1982). While it is true that evaluating some fixed sites that are stable in terms of land use and other stressors would ideally provide additional information on year-to-year variabilities across a wide range of conditions, resources were not available for this type of supplemental effort during the Round Two MBSS.

Statewide estimates of the percentage of stream miles falling into specific condition classes can be made using the three years (2000-2002) of Round Two data collected up to this point. These estimates will be further refined as Round Two of the MBSS is completed. Estimates from Round Two can be compared to estimates made using Round One data, to aid in the assessment of the change in stream condition over time.

Estimates of the percentage of stream miles falling into each condition class for both Round One and Round Two are presented in Figures 5-1 through 5-4. These figures indicate that statewide results from both Rounds of the MBSS are very similar. It can be concluded that the biological and physical condition of streams statewide have remained constant over time since Round One of the Survey.

Table 5-1. Variability in mean fish and benthic IBI scores between the 1995-1997 MBSS and the 2002 MBSS. Watersheds shown are those that contained 10 or more sites in the 1995-1997 MBSS.						
Watershed	**FIBI**	**Lower 90%**	**Upper 90%**	**BIBI**	**Lower 90%**	**Upper 90%**
Loch Raven Reservoir 1996	3.05	2.33	3.77	3.70	3.15	4.25
Loch Raven Reservoir 2002	2.89	2.49	3.29	3.41	3.15	3.67
Potomac River Montgomery County 1997	2.75	2.08	3.42	3.07	2.65	3.49
Potomac River Montgomery County 2002	2.82	2.50	3.14	3.27	2.96	3.58
Savage River 1996	4.21	2.78	5.64	3.73	2.94	4.52
Savage River 2002	2.90	2.58	3.22	4.06	3.87	4.25

Table 5-2. Variability in the percentage of fish and benthic IBI scores < 3 between the 1995-1997 MBSS and the 2002 MBSS. Watersheds shown are those that contained 10 or more sites in the 1995-1997 MBSS.						
Watershed	**Percentage of Stream Miles with FIBI < 3**	**Lower 90%**	**Upper 90%**	**Percentage of Stream Miles with BIBI < 3**	**Lower 90%**	**Upper 90%**
Loch Raven Reservoir 1996	30	13.96	50.78	12.5	3.5	29.23
Loch Raven Reservoir 2002	50	22.24	77.76	29.41	12.38	51.19
Potomac River Montgomery County 1997	63.63	34.98	86.49	50	24.53	75.47
Potomac River Montgomery County 2002	42.86	20.61	67.5	26.67	9.67	51.08
Savage River 1996	6.25	0.32	26.4	5.56	0.28	23.77
Savage River 2002	16.67	0.09	58.18	7.14	0.3	29.67



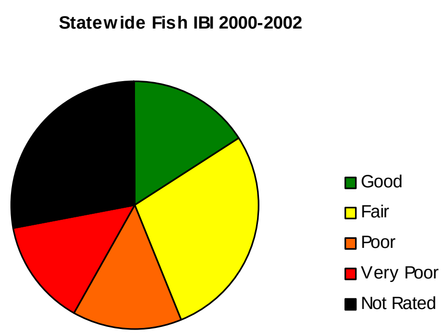


Figure 5-1. State estimates of the percentage of stream miles in Good, Fair, Poor and Very Poor condition classes for the Fish IBI in Round One and Round Two of the MBSS

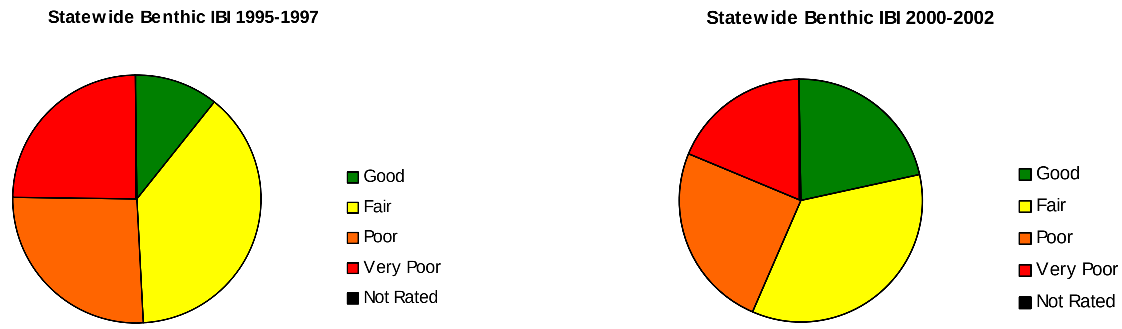


Figure 5-2. State estimates of the percentage of stream miles in Good, Fair, Poor and Very Poor condition classes for the Benthic IBI in Round One and Round Two of the MBSS

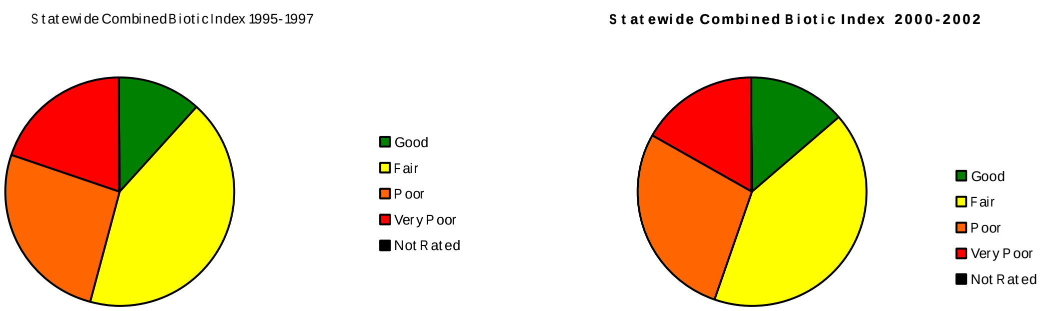


Figure 5-3. State estimates of the percentage of stream miles in Good, Fair, Poor and Very Poor condition classes for the Combined IBI in Round One and Round Two of the MBSS

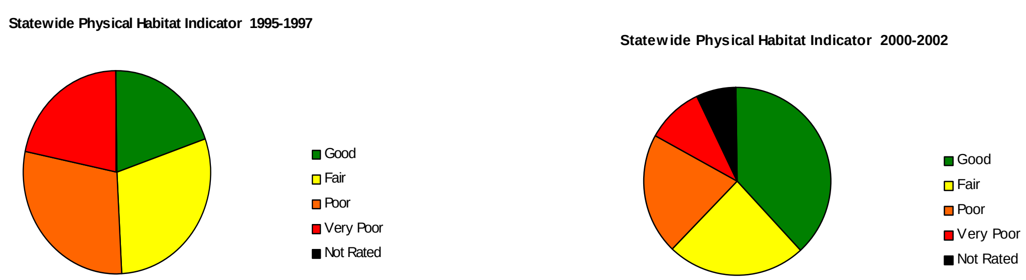


Figure 5-4. State estimates of the percentage of stream miles in Good, Fair, Poor and Very Poor condition classes for the Physical Habitat Indicator in Round One and Round Two of the MBSS

6 SENTINEL SITES

Round Two of the Maryland Biological Stream Survey (MBSS or the Survey) provides an opportunity to examine trends in stream conditions over time. However, to accurately assess temporal trends, it is necessary to differentiate between changes that result from anthropogenic influences and those that result from natural variation. The MBSS is monitoring annually a network of high quality reference sites, known as Sentinel Sites, to aid in assessing natural year-to-year variability in stream conditions.

In natural streams, variability in ecological condition among years should be attributable only to variations in precipitation and temperature regimes, as well as to biotic interactions among native species. Therefore, annual monitoring information from minimally disturbed sites in locations not likely to experience future anthropogenic disturbance (i.e., Sentinel Sites) offers the best means of interpreting the degree to which changes in biological indicator scores result from natural variability. Understanding the variability of disturbed sites is also important for evaluating status and trends. However, assuring that stressor conditions do not change at disturbed sites over time is more problematic. The Survey is not currently sampling fixed disturbed sites.

Although there are no longer any pristine streams in Maryland, monitoring a set of the best remaining streams offers a reasonable alternative for evaluating natural variability. During 2000, the Survey established the Sentinel Site network. In 2001 and 2002, the Survey continued annual sampling at a set of Sentinel Sites. The following sections describe the methods used to select these sites and presents the results from 2001 and 2002.

6.1 CANDIDATE SITES

To ensure that sites with minimal anthropogenic impacts were selected as long-term Sentinel Sites, a three-tier framework of land use, water quality, and biological community criteria was established and applied to all sites sampled by the MBSS from 1995 to 1999. The following Tier 1 criteria were used to identify candidate Sentinel Sites:

- No evidence of acid mine drainage in the site catchment
- Sulfate < 50 mg/l
- pH > 6.0 or DOC > 8.0 mg/l (i.e., pH could be < 6 if the stream is a naturally acidic blackwater)
- Nitrate nitrogen < 4.0 mg/l
- Percent forested land use > 50% of catchment area
- Combined Biotic Index (CBI, calculated as the simple mean of FIBI and BIBI scores) > 3.0, or coldwater or blackwater stream

In addition, streams not previously sampled quantitatively by MBSS, but likely to meet the above criteria, were included in the initial pool of candidate sites.

Candidate Sentinel Sites were grouped according to stream order and geographic region (Coastal Plain-Eastern Shore, Coastal Plain-Western Shore, Eastern Piedmont, or Highlands) to facilitate representation of small, medium, and large streams throughout Maryland. Criteria were also applied to ensure that the candidate sites were likely to remain minimally disturbed for the foreseeable future. The Tier 2 list of provisional sites was compiled using the following criteria:

- minimum of 5 sites in each geographic region
- minimum of 5 sites in each stream order (1st through 4th)
- a large amount of the catchment located within protected lands (e.g., The Nature Conservancy Preserves and State Forests), and
- sampling site itself located on public land.

Therefore, the provisional Sentinel Sites consisted of six or seven sites in each of the four geographic regions that appeared to have the least human disturbance and the least likelihood of changing in the future from human-related activities in their catchments. To compile the final Tier 3 selected Sentinel Sites, DNR biologists reviewed information from external sources and conducted site visits (when needed to confirm land use or other watershed conditions).

6.2 SITES SELECTED

Prior to the 2000 MBSS sampling season, 27 sites were selected for the Sentinel Site network using the three-tiered process based on the land use, water quality, and biological community criteria described above (Appendix Table D-1). These sites were either selected from sites sampled during Round One of the Survey, or from streams with existing ecological and land use information warranting their inclusion.

The 2000 Sentinel Site network was reviewed for potential changes in light of the 2000 sampling results and a slightly modified group was selected for 2001. Based on results from 2000, 24 of the 27 Sentinel Sites continued to meet the minimum Sentinel Site criteria. NASS-301-S-2000 was excluded from the Sentinel Site network because forested land use did not exceed 50% (42% forested land use). Two additional sites (WCHE-086-S-2000 and WYER-118-S-2000) were flagged for possible exclusion because the Combined Biotic Index (CBI) score in 2000 did not exceed 3.0 (and these sites were not coldwater or blackwater streams).

Of the 294 sites sampled by the Survey in 2002 (including the 27 Sentinel Sites), 91 met the criteria used to identify candidate Sentinel Sites. To ensure that adequate numbers of Sentinel Sites were available in each geographic region, new sites sampled in 2000 that met the candidate criteria were considered as potential substitutes for excluded Sentinel Sites. Site STMA-104-R-2000 was proposed as a replacement for WCHE-086-S-2000 (Coastal Plain-Western Shore). Site STMA-104-R-2000 is located on Warehouse Run in Saint Mary's County, a stream that has excellent water quality conditions, high biological index scores, and a catchment dominated by forested land use. Located on Kirby Creek in Queen Anne's County, CORS-102-R-2000, a blackwater stream with good water quality and a catchment dominated by forested land use, was proposed as a replacement for WYER-118-S-2000 (Coastal Plain-Eastern Shore; Appendix Table D-2). Because NASS-301-S-2000 was located on a minimally disturbed, blackwater stream, a replacement site (NASS-302-S-2001) was selected downstream in the watershed so that the percent forested land use would meet the minimum criterion. In addition, although JONE-322-S-2000, LOCH-102-S-2000, and LOCH-209-S-2000 (Eastern Piedmont) met the minimum Sentinel Site criteria based on sampled results in 2000, additional information revealed anthropogenic impacts that warranted their exclusion from the Sentinel Site network. At the same time, FURN-101-C-2000 and LIBE-102-C-2000 were selected as new Sentinel Sites. Both sites are located on streams that have excellent water quality with catchments dominated by forested land use. Following these changes, 26 Sentinel Sites were designated for sampling in 2001.

Of the 256 sites sampled by the Survey in 2001 (including the 26 Sentinel Sites), 76 met the criteria used to identify candidate Sentinel Sites. Of the 26 Sentinel Sites, 25 continued to meet the minimum Sentinel Site criteria after being sampled in 2001. Site WCHE-086-S-2001 did not meet criteria because the CBI score in 2001 was less than 3.0 (and the site is not located on a coldwater or blackwater stream). Because this site has not met the Sentinel Site criteria for two consecutive years, PAXM-106-R-2001was considered as a potential replacement. This alternate site is located on an unnamed tributary to Mataponi Creek in Prince George's County, and has good water quality and a CBI score that exceeds 4.00. However, WCHE-086-S-2001 did meet the Sentinel Site criteria in 2002 and will be retained in the network. To improve upon the existing Sentinel Site network in the Highlands region, SAVA-159-S-2001 was eliminated from the Sentinel Site list, and SAVA-204-C-2001 and UMON-119-S-2002 were added. Both sites are located on brook trout streams with excellent water quality and a catchment dominated by forested land use. Following these changes, 27 Sentinel Sites were designated for sampling in 2002 (Appendix Table D-2).

Of the 244 sites sampled by the Survey in 2002 (including the 27 Sentinel Sites), 61 met the criteria used to identify candidate Sentinel Sites (Appendix Table D-3). Of the 27 Sentinel Sites, 23 continued to meet the minimum Sentinel Site criteria after being sampled in 2002. The four Sentinel Sites that did not meet the criteria were all located in the Coastal Plain physiographic province. CORS-102-S-2002 and UPCK-113-S-2002 did not meet the Sentinel Site criteria because spring water chemistry data did not indicate blackwater conditions, despite the fact that previous data collected at these sites indicated that these appear to be blackwater streams. As a result, both of these sites will remain in the Sentinel Site network until further water quality data confirms that they should be excluded. In 2002, WIRH-220-S-2002 did not meet criteria because the nitrate-nitrogen concentration exceeded 4.0 mg/L. Water quality data collected over the past two years at this site suggests that land use changes within the watershed may be occurring. This site has been flagged for possible exclusion if water quality data from 2003 indicate elevated levels of nitrate-nitrogen. Lastly, MATT-033-S-2002 did not meet the Sentinel site criteria because the CBI score in 2002 did not exceed 3.0 (and this site is not located on a coldwater or blackwater stream). However, the Fish IBI component of the CBI was in the Poor category due to the extreme drought in 2002 which left this site with only a few standing pools. Therefore, variations in the CBI at this site are most likely due to natural variations. This site will remain in the Sentinel Site network. In the future, it is possible that other Sentinel Sites may be replaced and others added to ensure that adequate numbers of minimally disturbed sites are available to detect temporal trends in natural stream conditions.

6.3 INTERANNUAL VARIABILITY AT SENTINEL SITES

The Combined Biotic Index, which rates the health of a stream based on both benthic macroinvertebrate and fish communities, can be used as a tool to document temporal trends that result from natural variations. Although only four years of data currently exist for most of the Sentinel Sites (Appendix Table D-1), we examined the variability in the CBI over this period. Approximately 77% of the

CBI scores for each Sentinel Site varied by less than 1.0. Variability in the CBI was negligible for the Highland region (average range of CBI was 0.50 per site, maximum of 0.95), whereas the greatest variability in the CBI occurred for the Coastal Plain-Western Shore region (average of 0.98, maximum of 1.50). These analyses suggest that overall, stream conditions have remained relatively stable from 1995 through 2002.

Despite the fact that 2002 was a very dry year (refer to section 2.8 for details on climatic conditions during 2002), Sentinel Site CBI scores were not consistently low due to the drought and low flow conditions. However, the drought did negatively impact a few sites in the Coastal Plain physiographic province. CORS-102-S-2002 and WCHE-086-S-2002 both went dry in the summer of 2002. As a result, the only component of the CBI score was the BIBI. In addition, MATT-033-S-2002 consisted only of a few standing pools and had the lowest FIBI score in the four years that it has been sampled. This illustrates that although the drought was widespread, only certain watersheds were adversely impacted during the drought.

Although the years in which data were collected at each Sentinel Site varied, values for most of the parameters assessed were not dramatically different between years (Appendix Table D-1). The most notable changes included variations in the blackwater or brook trout designation for a site. For example, UPCK-113-S-2002 and CORS-102-S-2002 underwent changes in blackwater designations, based on the water chemistry definition of a blackwater system. In 2002, neither site met the dissolved organic carbon concentration and ANC requirements for blackwater designation, despite having met these criteria in previous years (Appendix Table D-1). JONE-109-S-2001 illustrates annual changes in brook trout designations, based on the presence of brook trout in the sample one year and their absence in the other year. In 2001, brook trout were not collected in the actual 75 meter long Sentinel Site, but qualitative sampling 20 meters downstream determined that brook trout were still present in this stream.

These changes in designation indicate that it is important to consider other available data in assigning coldwater or blackwater designations. For example, the use of temperature logger records will likely prove more reliable for identifying coldwater streams than relying on the capture of a single fish species. (This method should identify historically coldwater streams from which trout have been extirpated for reasons other than temperature). In addition, field observations and site-specific knowledge regarding blackwater conditions can augment the strictly water-chemistry based definition, which uses single-point-in-time data that do not capture natural variations in DOC, pH or ANC levels.

6.3 DISCUSSION

The existing Sentinel Site network contains some of the best freshwater streams in Maryland (i.e., minimally disturbed and least likely to change in the future from human-related activities) and includes first- through third-order streams within each geographic region. However, noticeable differences exist in the quality of these best streams in each of the four geographic regions. The Highlands stratum contains eight streams with no apparent anthropogenic impacts. All eight have excellent water quality conditions, good biological index scores, and a catchment dominated by forested land use (76% or greater; Appendix Table D-1). Conversely, it was difficult to identify sites of comparable quality in the Coastal Plain-Western Shore, Eastern Piedmont, and especially the Coastal Plain-Eastern Shore. Although a number of sites in these regions met the minimum criteria for candidate Sentinel Sites, few were truly excellent. Frequently anthropogenic impacts (mostly resulting from agricultural land use) were present to some degree. Therefore, it is important to maintain adequate numbers of Sentinel Sites in all Maryland regions, while recognizing that the quality of sites varies among regions.

The Survey's Sentinel Site network is a valuable tool for interpreting stream conditions over time and informing water resources management. One potential use would be to adjust individual site fish and benthic IBI scores relative to the scores obtained at the Sentinel Sites. For example, in years where Sentinel Site scores were consistently low (as a result of natural variation such as drought and low flow conditions), random sites sampled that year would have their scores adjusted upward by the amount the Sentinel Site were lower than normal. Raw scores would be retained for most analyses, but adjusted scores could be used in water resources management to provide fair assessments across watersheds sampled in different years. These adjustments will be undertaken at the end of the five-year Round Two sampling, when a more accurate picture of natural variability is attained.

Ultimately, the utility of the Sentinel network will depend upon whether land use changes or other impacts arise in a significant number of Sentinel Site catchments, thereby reducing the ability of the network to define natural variability. Future sampling will determine whether high quality conditions continue at the locations included in the Sentinel Site network. As needed, Sentinel Sites may be replaced to ensure that adequate numbers of undisturbed sites are available in each geographic region. We hope that after several years, the Sentinel Site network will provide an accurate picture of the temporal variability in the best remaining streams in Maryland.

7 MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

The goal of the Maryland Biological Stream Survey (MBSS or Survey) is to provide natural resource managers, policymakers, and the public with the information they need to make effective natural resource decisions about the State's non-tidal streams and the watersheds they drain. For this reason, the Survey was designed to answer an initial set of 64 management questions. In the Round One report (Roth et al. 1999), many of these questions were answered, while some remained unanswered and new questions were raised. Many of the answers were the first scientifically defensible and management-relevant answers obtained for these questions.

By the end of Round One, it was apparent that certain management concerns had changed and programmatic needs were evolving. The changes instituted in Round Two were designed to address this changing management context without losing comparability with Round One data. This chapter focuses on the management implications of the results obtained in 2002, recognizing that this sampling year is only one of five and that many questions will only be answered after Round Two is completed. In addition to implications of the core survey results, this chapter discusses the future sampling and monitoring/assessment activities planned for Round Two and beyond.

7.1 MANAGEMENT IMPLICATIONS

Information from Round One of the Survey is being used to support management and policy initiatives at DNR. Results from sampling in Round Two will be used to help refine answers to the MBSS questions and to address new issues that arise. In addition to serving DNR's program needs, a number of other agencies and institutions have an interest in the Survey's answers to its primary objectives:

- assess the current status of biological resources in Maryland's non-tidal streams;
- quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- provide a statewide inventory of stream biota; establish a benchmark for long-term monitoring of trends in these biological resources; and
- target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

Chesapeake Bay Agreement. The information being obtained by the Survey is expected to be useful for achieving the new stream corridor commitments of the Chesapeake Bay Program. The Chesapeake 2000 Agreement (signed by Virginia, Maryland, Pennsylvania, District of Columbia, U.S. EPA, and Chesapeake Bay Commission) newly recognizes "the need to focus on the individuality of each river, stream and creek" to meet the goal—"Preserve, protect and restore those habitats and natural areas that are vital to the survival and diversity of the living resources of the Bay and its rivers." Specifically, the Agreement commits to the following watershed-based actions:

- Develop and implement watershed management plans in two-thirds of the Bay watershed
- Develop guidelines to ensure the aquatic health of stream corridors
- Select pilot projects that promote stream corridor protection and restoration
- Make available information concerning the aquatic health of stream corridors
- Develop stream corridor restoration goals based on local watershed management planning

Results from the Round Two sampling will be used to support these actions, just as Round One results were provided to the State's Tributary Strategies program to address the Bay Program's nutrient reduction goals.

Maryland Land Conservation. The stream corridor information provided by the Survey will also prove invaluable for statewide programs such as the riparian buffer restoration, Rural Legacy, and GreenPrint initiatives. As part of the Chesapeake Bay-wide goal of restoring 2,010 miles of riparian buffers in the Chesapeake Bay watershed by the year 2010, Maryland is restoring 600 miles of riparian vegetation along its stream corridors. MBSS ground verification of remotely sensed riparian areas can be used, along with data on ecological stream condition, to determine where restoration will provide the greatest ecological and economic benefit. In a separate initiative, Maryland has designated substantial funding to purchase GreenPrint lands that will contribute to an interconnected green infrastructure across the state. Stream corridors are an important part of the contiguous forest and wetland habitats that make up the green infrastructure (linked hubs and corridors worthy of preservation or restoration). MBSS data on the condition of constituent streams will help assign priorities for the purchase of GreenPrint lands.

Clean Water Action Plan. The results of Round Two will continue to support Maryland's participation in the federal Clean Water Action Plan. Round One MBSS data were an essential component of the first Unified Watershed Assessment prepared under this Plan; specifically, DNR incorporated mean values by Maryland 8-digit watersheds for both the fish IBI and benthic IBI. These indicators provided some of the best information provided to U.S. EPA by any state. These IBIs were used with other indicators to help designate both Category 1 (priorities for restoration) and Category 3 (priorities for protection) watersheds within Maryland. Watershed Restoration Action Strategies are being developed for five of these priority watersheds, using MBSS and other data: Georges Creek (Allegany County), Little Patuxent River (Howard County), Middle Chester River (Kent County), Manokin River (Somerset County), and Coastal Bays (Worcester County). Because the design of Round Two focuses on the finer geographic scale of Maryland 8-digit watersheds, future Unified Watershed Assessments will be more complete and Watershed Restoration Action Strategies more easily implemented.

Water Quality Standards. In addition to supporting these targeting initiatives, the identification of degraded stream segments has implications for comprehensive protection under the Clean Water Act. Section 101 of the Act states that physical, chemical, and biological integrity of waters should be maintained. Stream segments that fail to do this can be designated as degraded and not attaining designated uses as part of their water quality standards. The Maryland Department of the Environment (MDE) implements the water quality standards program and prepares a 303(d) list of streams not meeting their designated uses.

U.S. EPA continues to encourage Maryland and other states to use biological criteria (biocriteria) to meet negotiated agreements for expanding their 303(d) lists. In response, MDE, DNR, and a multi-jurisdictional advisory group developed an interim biocriteria framework that incorporates stream ratings based on fish and benthic IBIs developed by the Survey (Roth et al. 2000, Stribling et al. 1998) to identify 8-digit watersheds and 12-digit subwatersheds that are impaired. Using combined Round One and 2000 MBSS data, these impairments have been included in the biennial 305(b) water quality report and the "Draft Methodologies for Listing Pollution Impaired Waterbodies on the 2002 303(d) List." Specifically, 178 biological impairments are included in the 2002 Integrated 303(d) List based on MBSS stream ratings of Poor or Very Poor. Ultimately, total maximum daily loads (TMDLs) must be developed for streams on this list for which an impairing substance (a pollutant) can be identified. Currently, MDE is exploring ways of using MBSS data to support development of a large number of nutrient, sediment, and other TMDLs over the next few years.

Another important use of MBSS biological data for the water quality standards program is refinement of aquatic life use designations. Each water body in Maryland has an associated designated use that (along with appropriate physical, chemical, and biological criteria, and antidegradation provisions) make up the water quality standard for that water body. While some streams have a special use, such as a reproducing trout stream, most have the same general aquatic life use (Antidegradation Tier 1). This general use designation does not capture the natural variability of Maryland streams and therefore does not extend any special protection to streams with unusually high biodiversity or ecological value. U.S. EPA is encouraging states to refine their aquatic life uses into categories with more precise biocriteria and greater antidegradation protections. Maryland is currently developing an Outstanding National Resource Water Antidegradation Tier 3, while evaluating approaches for an Antidegradation Tier 2 that is better than the minimum standard of "support of balanced indigenous populations and support of contact recreation," commonly referred to as "fishable-swimmable." Data from the Survey will be critical to establishing aquatic life use designations and biocriteria in streams for these tiers.

Maryland Biodiversity. The information on biological diversity collected by the Survey exceeds that needed to designate the ecological condition of individual watersheds. The extensive geographic reach and quantitative sampling results of the Survey provide an unusual opportunity for evaluating the distribution and abundance of species previously designated as rare only by anecdotal evidence. For example, the endemic checkered sculpin and several other species have been collected by the Survey in previously unreported locations. Based on the information gathered in Round One, Maryland DNR's Heritage and Biodiversity Programs are reevaluating state designations of rare, threatened, and endangered species. MBSS sampling in 2003 will include a targeted component to refine the distribution of rare fish species. These reevaluations, as well as MBSS data on unique combinations of species at the ecosystem and landscape levels, will provide critical new information to support biodiversity conservation in the state.

Support of Local Monitoring Programs. One of the most promising trends related to the Survey has been the increase in interest and activity among Maryland county governments, non-governmental organizations, private businesses, and volunteers in stream monitoring. The success of the Survey has encouraged these groups to base their water resource management more directly on monitoring results. Many have instituted their own monitoring programs, often drawing upon or adopting MBSS sampling protocols. Maryland DNR has facilitated this trend by providing training each year to interested individuals.

Montgomery County is an example of a local government that has instituted an extensive stream monitoring program, and that is working closely with the Survey to integrate program activities, so that sampling is more cost-effective and assessment results are consistent and more precise. In addition, Maryland DNR has implemented a Stream Waders program that combines volunteer sampling effort with professional laboratory processing and quality assurance to greatly increase the number of streams that can be sampled. These efforts to support local stream monitoring will ultimately result in improved water resource management at all levels.

7.2 FUTURE DIRECTIONS

At the end of Round One, it was discovered that most of the original 64 MBSS questions that could not yet be answered dealt with identifying potential stressors using data not collected as part of the Survey. Much of this information will be gathered from other sources and linked to MBSS sites so that statewide estimates can be made of stressor extent (e.g., number of stream miles with point sources of contamination, amounts of pesticides applied by geographic area, or pattern of landscape patches in upstream catchments). The other issues of original and new interest dealt in large part with the need for finer geographic resolution. As described above, the Round Two design (including adoption of the new 1:100,000-scale stream network, focus on Maryland 8-digit watersheds, and volunteer monitoring at the 12-digit subwatershed scale) begins to provide this desired resolution. Issues that require continued scrutiny in future years include the following:

- Extending the Survey into tidal streams
- Delineating more stream types requiring new indicators (e.g., coldwater and blackwater streams)
- Refining existing indicators (e.g., benthic macroinvertebrate and physical habitat) and developing new ones (e.g., streamside salamanders in small streams)
- Better characterization of existing and new stressors (e.g., estimating the contribution of eroded soil to sediment loading and the possible adverse effect of low flows resulting from water withdrawals)
- Improving identification of rare species habitats and other biodiversity components
- Comparing among sample rounds for the detection of trends
- More coordination with counties for greater sample density or cost savings in areas of shared interest

<u>Better Stream Coverage</u>. Round Two is capturing considerably more small streams and a few more larger streams than in Round One. This increased effort provides nearly comprehensive coverage of the stream resources in Maryland. The principal remaining gap is tidal streams, those not covered by tidewater monitoring at DNR. The Round Two design includes a component dedicated to tidal stream sampling that has not yet been implemented because of lack of funding. Specifically, the Round Two design includes pilot sampling of tidal streams that follows the lattice design used for non-tidal streams and includes the same subset of 84 watersheds for sampling each year. A random sample of 20 sites would be selected within each watershed containing tidal streams, and the number of sites allocated to each watershed would be proportional to their tidal stream length.

<u>Development of New or Refined Stream Indicators</u>. Analysis of Round One data revealed that Maryland contains substantial miles of streams that are ecologically distinct in terms of natural fish communities. Three kinds of streams were identified where the existing fish IBI is not an effective indicator of stream condition: (1) small streams draining catchments of less than 300 acres, (2) coldwater streams characterized by lower temperatures and prevalence of trout species, and (3) blackwater streams characterized by low pH and high organic content. In each case, separate reference conditions likely need to be used to develop appropriate indicators for these stream types. Recent analysis of MBSS data from limestone streams (characterized by high alkalinity and pH) indicated that separate reference conditions are not needed for these streams. Similar analysis of an independent U.S. EPA data set from the Mid-Atlantic Highlands came to the same conclusion.

Targeted sampling of MBSS streams for streamside salamanders was conducted in 2001 and 2002 in cooperation with the U.S. Geological Survey. Analysis of these data concluded that a stream salamander Index of Biotic Integrity (SS-IBI) incorporating four metrics (number of species, number of salamanders, percentage of adults, and percentage of intolerant salamanders) is an effective discriminator of stream condition in small streams. This would provide the Survey with a second vertebrate indicator for streams draining less than 300 acres, when stream salamanders are sampled. Temperature loggers were deployed at nearly all randomly selected stream sites in 2002 (and will continue to be deployed throughout Round Two) to improve our ability to identify current coldwater streams. Historically coldwater, but currently degraded to warmwater conditions streams, may be identifiable using historic, geologic, and other geographic data. Round Two also includes ancillary sampling of coldwater and blackwater streams (which occur in too low proportions of total streams to be captured adequately by the core survey) that will be used to support development of appropriate fish IBIs for these streams. In both 2000 through 2001, 16 ancillary coldwater sites were sampled in both stressed and healthy coldwater streams; additional sampling of blackwater streams is planned for future years. Analysis of existing coldwater and blackwater stream data has begun in hopes of developing separate reference conditions, and ultimately separate indicators, for these stream types.

In Round One, a provisional indicator of physical habitat quality, the Physical Habitat Index (PHI), was developed from the quantitative and qualitative data collected in 1995-1997. The approach focused on including only those parameters that were significantly correlated with biological characteristics of interest. In 2001 and 2002, the Survey revisited its approach for assessing stream physical habitat quality by reanalyzing all existing physical habitat data and developing a new indicator independent of biological data. The MBSS plans to apply this new PHI into statewide MBSS analyses at the conclusion of Round Two.

Better Characterization of Stream Stressors. Effective characterization of stressors will continue to be an important part of the Survey. In many cases, accurate diagnosis of site-specific problems is beyond the capabilities of the Survey and follow-up monitoring is required. This will be the case in most watersheds highlighted for possible inclusion on the state's 303d list of impaired waters. Only when specific causes of degradation are identified and quantified can TMDLs be developed. Nonetheless, the Survey will continue to investigate new analyses of stressor data and produce estimates of the extent and severity of problems to help in natural resource management decision making.

In 2001, the Survey had two papers accepted that address the issue of stressor diagnosis in freshwater streams. One study analyzed MBSS data in drainage basins of mixed land uses and determined that urban land use is a strong indicator of the likelihood that IBIs will fail biocriteria thresholds. The model developed in this study can be used to screen out land use effects when searching for other stressors. In addition, the Survey developed an "expected species model" that diagnoses ecological stressors to stream fishes using species tolerances to 31 physical, chemical, and landscape variables. Like the other study, this approach found that impervious land cover was the most influential stressor on Maryland streams in terms of severity and extent.

Throughout Round Two, new information is being gathered on riparian buffer, exotic plants, channelization, bar formation, and bank erosion. The total area of eroding banks was reported as an indicator of the amount of sediment being contributed downstream by each watershed. Additional analysis is underway for MDE to identify individual or composite sediment indicators that can be used to identify watersheds degraded by sediment. In future years, statistics on these and other stressors will be developed.

Maryland Biodiversity. As Round Two continues to sample new streams throughout the state, we expect that new location records for many species will be reported. As these records accumulate, the Survey will make them available to the Maryland DNR Heritage and Biodiversity Programs for future listing reevaluations and management planning. The Survey will also conduct more analysis on unique combinations of species at the ecosystem and landscape levels. Specifically, biodiversity maps based on Round One MBSS data and rare, threatened, and endangered species data will be augmented with Round Two data and GAP analysis data developed by the Heritage and Biodiversity Programs and U.S. Fish and Wildlife Service.

At present, little work has been done to prepare species-specific management plans for unique or at-risk aquatic species. Because the Survey collects information that can be used to identify stressors within a watershed, MBSS data can serve as a logical starting point for developing restoration and protection strategies. Given that the Survey has produced abundance estimates for rare and unique fishes, prioritization of management plan development can be based on population size and known threats. In 2003, the Survey will conduct targeted sampling for the Maryland DNR Heritage and Biodiversity Programs to refine the distributions of selected rare fishes.

One of the most important benefits of collecting Round Two data will be the ability of the Survey to compare results over time and detect trends in natural variability, environmental degradation, and restoration success. The sampling in Round Two provides the first opportunity to compare stream condition in selected watersheds across the two rounds. Once Round Two is completed in 2004, rigorous statewide estimates with ample sample density will be used to investigate trends. The interpretation of trends requires that natural temporal change be characterized and understood. To this end, Round Two will continue to annually monitor 25 sentinel sites selected and sampled in 2000. These sites represent the best stream conditions in the state and focus on those areas least likely to change through anthropogenic impact (e.g., in state-managed or protected areas). As Round

Two progresses, data from annual sampling of sentinel sites will be analyzed for natural temporal variability.

Integration with Local Monitoring Programs. Recognizing that the core and ancillary sampling by Maryland DNR will never be able to attain the sample density needed for all management decisions in the state, the Survey is focusing on coordination with other monitoring programs (usually county governments) during Round Two. In 2000, comparability analyses were conducted with the biological sampling program of Montgomery County with funding from U.S. EPA. Differences in sample frame, survey design, sampling methods, indicator construction, and reporting were investigated and procedures for combining the results of the two programs were developed. In 2001, a experimental methods comparison study for benthic sampling was conducted that evaluated the effectiveness and comparability of differences in sampling gear, size of subsamples, and level of taxonomy. Using these and other analyses, the Survey has developed guidance and data quality standards for sharing of information.

To the extent possible, sampling results (e.g., fish and benthic IBIs) are being integrated into combined estimates for public reporting throughout Round Two. To date, monitoring data from Montgomery and Howard Counties have been combined with MBSS data in watersheds sampled concurrently to produce more precise estimates of condition. The Survey will continue coordination with Montgomery, Prince George's, Howard, Baltimore, and other counties plus Baltimore City, in future years to ensure that programs obtain either greater sample densities or cost savings (from sharing sample sites) for monitoring Maryland streams. The Maryland Water Monitoring Council (MWMC) is playing an active role in encouraging these collaborations between state and local agencies.

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APPENDIX A
PRECIPITATION DATA

Table A-1. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 1998

Region	Jan-98	Deviation	Feb-98	Deviation	Mar-98	Deviation	Apr-98	Deviation	May-98	Deviation	Jun-98	Deviation	Jul-98	Deviation
Southern Eastern Shore	8.04	4.40	6.98	3.55	4.65	0.53	3.12	-0.05	4.46	1.00	5.15	1.76	1.52	-2.53
Central Eastern Shore	7.41	3.83	6.34	3.08	5.33	1.59	3.19	0.44	3.39	-0.56	5.10	1.45	1.40	-2.54
Lower Southern	6.69	3.41	7.00	3.96	6.35	2.66	3.51	0.32	4.29	0.21	6.95	3.23	1.02	-2.94
Upper Southern	5.77	2.72	5.94	3.00	6.37	2.96	3.75	0.43	4.74	0.52	4.01	0.31	1.69	-2.32
Northern Eastern Shore	5.65	2.38	4.30	0.98	6.03	2.48	3.65	0.37	4.92	0.91	4.92	0.93	3.42	-0.38
Northern Central	6.00	2.92	4.93	1.96	6.34	2.81	3.94	0.41	5.51	1.14	4.67	0.69	3.17	-0.63
Appalachian Mountain	4.50	1.89	5.29	2.74	3.32	0.01	4.76	1.32	3.91	-0.02	4.44	0.99	2.76	-0.78
Allegany Plateau	4.74	1.56	4.38	1.43	3.44	-0.52	5.54	1.47	5.01	0.64	6.54	2.46	3.29	-1.57
Average for State	6.10	2.89	5.65	2.59	5.23	1.57	3.93	0.59	4.53	0.48	5.22	1.48	2.28	-1.71

Table A-1. (Continued)

Region	Aug-98	Deviation	Sep-98	Deviation	Oct-98	Deviation	Nov-98	Deviation	Dec-98	Deviation	Annual	Deviation
Southern Eastern Shore	2.75	-2.12	1.53	-1.88	1.01	-2.17	1.10	-2.02	3.67	0.26	43.98	0.73
Central Eastern Shore	3.02	-1.38	1.34	-2.17	2.58	-0.49	1.02	-2.30	4.20	0.64	44.92	1.59
Lower Southern	1.55	-2.42	0.50	-3.17	1.28	-1.96	1.17	-2.22	2.50	-0.83	42.81	0.25
Upper Southern	1.31	-2.86	1.79	-1.79	0.92	-2.39	1.27	-2.16	1.79	-1.58	39.32	-3.16
Northern Eastern Shore	3.03	-0.85	2.86	-0.79	1.36	-1.78	0.90	-2.49	1.87	-1.82	42.63	-0.06
Northern Central	2.57	-1.28	1.82	-1.89	2.82	-0.52	1.10	-2.48	1.19	-2.28	44.06	0.85
Appalachian Mountain	2.29	-1.05	1.74	-1.46	1.33	-1.84	0.25	-2.86	0.85	-1.97	35.44	-3.03
Allegany Plateau	3.74	-0.09	3.26	-0.06	1.49	-1.68	0.48	-3.08	1.30	-2.38	43.21	-1.82
Average for State	2.53	-1.51	1.86	-1.65	1.60	-1.60	0.91	-2.45	2.17	-1.25	42.05	-0.58

Table A-2. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 1999 (NOAA 1999)

Region	Jan-99	Deviation	Feb-99	Deviation	Mar-99	Deviation	Apr-99	Deviation	May-99	Deviation	Jun-99	Deviation	Jul-99	Deiviation
Southern Eastern Shore	4.98	1.34	2.90	-0.53	4.65	0.53	3.12	-0.05	4.46	1.00	5.15	1.76	3.80	-0.25
Central Eastern Shore	5.68	2.10	2.58	-0.68	5.33	1.59	3.19	0.44	3.39	-0.56	5.10	1.45	4.93	0.99
Lower Southern	5.20	1.92	2.20	-0.84	6.35	2.66	3.51	0.32	4.29	0.21	6.95	3.23	2.21	-1.75
Upper Southern	5.43	2.38	2.34	-0.60	6.37	2.96	3.75	0.43	4.74	0.52	4.01	0.31	1.72	-2.29
Northern Eastern Shore	4.84	1.57	3.17	0.13	6.03	2.48	3.65	0.37	4.92	0.91	4.92	0.93	3.61	-0.19
Northern Central	6.02	2.94	3.04	0.07	6.34	2.81	3.94	0.41	5.51	1.14	4.67	0.69	1.60	-2.20
Appalachian Mountain	4.30	1.69	1.50	-1.05	3.32	0.01	4.76	1.32	3.91	-0.02	4.44	0.99	1.79	-1.75
Allegany Plateau	4.97	1.79	2.30	-0.65	3.44	-0.52	5.54	1.47	5.01	0.64	6.54	2.46	3.04	-1.82
Average for State	5.18	1.97	2.50	-0.52	5.23	1.57	3.93	0.59	4.53	0.48	5.22	1.48	2.84	-1.16

Table A-2. (Continued)

Region	Aug-99	Deviation	Sep-99	Deviation	Oct-99	Deviation	Nov-99	Deviation	Dec-99	Deviation	Annual	Deviation
Southern Eastern Shore	4.57	-0.30	9.19	5.78	4.70	1.52	1.70	-1.42	2.39	-1.02	45.80	2.55
Central Eastern Shore	4.55	0.15	12.86	9.35	3.36	0.29	1.93	-1.39	2.59	-0.97	48.11	4.78
Lower Southern	6.61	2.64	11.75	8.08	3.50	0.26	1.45	-1.94	2.25	-1.08	46.02	3.46
Upper Southern	5.68	1.51	12.21	8.63	2.66	-0.65	2.18	-1.22	3.08	-0.29	46.55	4.07
Northern Eastern Shore	4.43	0.55	16.13	12.48	3.19	0.05	2.30	-1.09	2.42	-1.27	50.84	8.15
Northern Central	4.51	0.663	10.78	7.07	2.88	-0.46	2.01	-1.57	3.10	-0.37	44.99	1.78
Appalachian Mountain	2.27	- 1.07	5.45	2.25	2.26	-0.91	1.72	-1.39	2.07	-0.75	34.34	-4.13
Allegany Plateau	2.08	-1.75	3.46	0.14	2.85	-0.32	3.31	-0.25	1.98	-1.70	37.61	-7.42
Average for State	4.34	0.30	10.23	6.72	3.18	-0.03	2.08	-1.28	2.49	-0.93	44.28	1.66

Table A-3. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 2000 (NOAA 2000)

Region	Jan-01	Deviation	Feb-01	Deviation	Mar-01	Deviation	Apr-01	Deviation	May-01	Deviation	Jun-01	Deviation	Jul-01	Deviation
Southern Eastern Shore	2.53	-1.11	2.66	-0.77	6.19	2.07	2.66	-5.10	3.72	0.26	3.93	0.54	4.84	0.79
Central Eastern Shore	3.51	-0.07	2.67	-0.59	5.57	1.83	1.54	-1.81	5.17	1.22	5.72	2.07	5.08	1.14
Lower Southern	NA	NA	2.30	-0.74	5.00	1.31	1.61	-1.58	6.73	2.65	5.27	1.55	7.73	3.77
Upper Southern	2.75	-0.30	2.22	-0.72	4.81	1.40	1.82	-1.50	5.01	0.79	5.17	1.47	5.25	1.24
Northern Eastern Shore	3.26	-0.01	3.26	0.22	5.78	2.23	1.97	-1.31	5.78	1.77	3.34	-0.65	6.22	2.42
Northern Central	3.98	0.90	1.94	-1.03	4.67	1.14	2.31	-1.22	3.76	-0.61	4.47	0.49	2.05	-1.75
Appalachian Mountain	1.94	-0.67	1.00	-1.55	4.00	0.69	2.30	-1.14	5.00	1.07	4.52	1.07	3.38	-0.16
Allegany Plateau	2.85	-0.33	1.76	-1.19	4.15	0.19	2.72	-1.35	4.70	0.33	6.30	2.22	6.83	1.97
Average for State	2.97	-0.23	2.23	-0.80	5.02	1.36	2.12	-1.88	4.98	0.94	4.84	1.10	5.17	1.18

Table A-3. (Continued)

Region	Aug-01	Deviation	Sep-01	Deviation	Oct-01	Deviation	Nov-01	Deviation	Dec-01	Deviation	Annual	Deviation
Southern Eastern Shore	6.11	1.24	1.74	-1.67	1.08	-2.10	0.06	-3.06	2.22	-1.19	37.74	-5.51
Central Eastern Shore	6.47	2.07	1.87	-1.64	1.01	-2.06	0.40	-2.92	1.97	-1.59	40.98	-2.35
Lower Southern	NA	NA	2.54	-1.13	0.88	-2.36	0.97	-2.42	1.98	-1.35	NA	NA
Upper Southern	4.87	0.70	2.48	-1.10	0.85	-2.46	1.28	-2.12	1.58	-1.79	38.09	-4.39
Northern Eastern Shore	NA	NA	3.18	-0.47	0.80	-2.34	1.36	-2.03	1.51	-2.18	NA	NA
Northern Central	3.11	-0.74	3.93	0.22	0.97	-2.37	1.70	-1.88	1.79	-1.68	34.68	-8.53
Appalachian Mountain	3.07	-0.27	2.06	-1.14	0.69	-2.48	1.40	-1.71	1.83	-0.99	31.19	-7.28
Allegany Plateau	2.84	-0.99	1.83	-1.49	131.00	-1.86	1.08	-2.48	3.12	-0.56	39.49	-5.54
Average for State	4.41	0.34	2.45	-1.05	17.16	-2.25	1.03	-2.33	2.00	-1.42	37.03	-5.60

Table A-4. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 2001 (NOAA 2001)

Region	Jan-01	Deviation	Feb-01	Deviation	Mar-01	Deviation	Apr-01	Deviation	May-01	Deviation	Jun-01	Deviation	Jul-01	Deviation
Southern Eastern Shore	2.53	-1.11	2.66	-0.77	6.19	2.07	2.66	-5.10	3.72	0.26	3.93	0.54	4.84	0.79
Central Eastern Shore	3.51	-0.07	2.67	-0.59	5.57	1.83	1.54	-1.81	5.17	1.22	5.72	2.07	5.08	1.14
Lower Southern	NA	NA	2.30	-0.74	5.00	1.31	1.61	-1.58	6.73	2.65	5.27	1.55	7.73	3.77
Upper Southern	2.75	-0.30	2.22	-0.72	4.81	1.40	1.82	-1.50	5.01	0.79	5.17	1.47	5.25	1.24
Northern Eastern Shore	3.26	-0.01	3.26	0.22	5.78	2.23	1.97	-1.31	5.78	1.77	3.34	-0.65	6.22	2.42
Northern Central	3.98	0.90	1.94	-1.03	4.67	1.14	2.31	-1.22	3.76	-0.61	4.47	0.49	2.05	-1.75
Appalachian Mountain	1.94	-0.67	1.00	-1.55	4.00	0.69	2.30	-1.14	5.00	1.07	4.52	1.07	3.38	-0.16
Allegany Plateau	2.85	-0.33	1.76	-1.19	4.15	0.19	2.72	-1.35	4.70	0.33	6.30	2.22	6.83	1.97
Average for State	2.97	-0.23	2.23	-0.80	5.02	1.36	2.12	-1.88	4.98	0.94	4.84	1.10	5.17	1.18

Table A-4. (Continued)

Region	Aug-01	Deviation	Sep-01	Deviation	Oct-01	Deviation	Nov-01	Deviation	Dec-01	Deviation	Annual	Deviation
Southern Eastern Shore	6.11	1.24	1.74	-1.67	1.08	-2.10	0.06	-3.06	2.22	-1.19	37.74	-5.51
Central Eastern Shore	6.47	2.07	1.87	-1.64	1.01	-2.06	0.40	-2.92	1.97	-1.59	40.98	-2.35
Lower Southern	NA	NA	2.54	-1.13	0.88	-2.36	0.97	-2.42	1.98	-1.35	NA	NA
Upper Southern	4.87	0.70	2.48	-1.10	0.85	-2.46	1.28	-2.12	1.58	-1.79	38.09	-4.39
Northern Eastern Shore	NA	NA	3.18	-0.47	0.80	-2.34	1.36	-2.03	1.51	-2.18	NA	NA
Northern Central	3.11	-0.74	3.93	0.22	0.97	-2.37	1.70	-1.88	1.79	-1.68	34.68	-8.53
Appalachian Mountain	3.07	-0.27	2.06	-1.14	0.69	-2.48	1.40	-1.71	1.83	-0.99	31.19	-7.28
Allegany Plateau	2.84	-0.99	1.83	-1.49	131.00	-1.86	1.08	-2.48	3.12	-0.56	39.49	-5.54
Average for State	4.41	0.34	2.45	-1.05	17.16	-2.25	1.03	-2.33	2.00	-1.42	37.03	-5.60

Table A-5. Total monthly precipitation (inches) and deviation from normal for Maryland regions in 2002 (NOAA 2002)

Region	Jan-02	Deviation	Feb-02	Deviation	Mar-02	Deviation	Apr-02	Deviation	May-02	Deviation	Jun-02	Deviation	Jul-02	Deviation
Southern Eastern Shore	2.98	-0.66	1.02	-2.41	5.08	0.96	5.30	2.13	1.85	-1.61	2.84	-0.55	1.68	-2.37
Central Eastern Shore	2.74	-0.84	0.67	-2.59	4.55	0.81	3.98	0.63	2.10	-1.85	1.85	-1.80	1.47	-2.47
Lower Southern	2.29	-0.99	0.61	-2.43	4.74	1.05	2.95	-0.24	1.82	-2.26	3.39	-0.33	1.84	-2.12
Upper Southern	1.87	-1.18	0.34	-2.60	3.66	0.25	3.90	0.58	3.22	-1.00	2.24	-1.46	2.72	-1.29
Northern Eastern Shore	2.55	-0.72	0.63	-2.41	NA	NA	3.09	-0.19	4.37	0.36	1.88	-2.11	2.87	-0.93
Northern Central	2.07	-1.01	0.39	-2.28	4.03	0.50	2.77	-0.76	3.62	-0.75	2.94	-1.04	2.58	-1.22
Appalachian Mountain	1.83	-0.78	0.31	-2.24	4.04	0.70	4.17	0.73	4.34	0.41	3.22	-0.23	2.98	-0.56
Allegany Plateau	2.47	-0.71	0.81	-2.14	4.33	0.37	6.08	2.01	6.08	1.71	3.25	-0.83	5.77	0.91
Average for State	2.35	-0.86	0.60	-2.39	4.35	0.66	4.03	0.61	3.43	-0.62	2.70	-1.04	2.74	-1.26

Table A-5. (Continued)

Region	Aug-02	Deviation	Sep-02	Deviation	Oct-02	Deviation	Nov-02	Deviation	Dec-02	Deviation	Annual	Deviation
Southern Eastern Shore	3.36	-1.51	9.24	5.83	7.06	3.88	5.45	2.33	3.61	0.20	49.47	6.22
Central Eastern Shore	1.58	-2.82	4.66	1.15	6.55	3.48	4.82	1.50	3.62	0.06	38.59	-4.74
Lower Southern	2.63	-1.34	2.10	-1.57	7.11	3.87	4.55	1.16	4.64	1.31	38.67	-3.89
Upper Southern	3.31	-0.96	3.83	0.25	6.31	3.00	5.12	1.72	4.73	1.36	41.15	-1.33
Northern Eastern Shore	1.81	-2.07	4.22	0.57	6.93	3.79	5.34	1.95	5.34	1.65	NA	NA
Northern Central	3.38	-0.47	4.43	0.72	6.36	3.02	3.92	0.34	4.59	1.12	41.08	-2.13
Appalachian Mountain	3.21	-0.13	3.87	0.67	5.49	2.32	3.42	0.31	3.59	0.77	40.44	1.97
Allegany Plateau	2.39	-1.44	3.43	0.11	5.13	1.96	3.46	-0.10	3.18	-0.50	46.38	1.35
Average for State	2.71	-1.34	4.47	0.97	6.37	3.17	4.51	1.15	4.16	0.75	42.25	-0.36

APPENDIX B
PARAMETER ESTIMATES BY PSU

Table B-1. Fish IBI					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	2.56	2.75	1.30	1.00	3.75
Nanticoke River	2.53	2.75	0.63	1.50	3.25
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	3.85	4.25	0.78	3.00	4.50
Middle Chester River	2.94	3.00	0.58	2.25	4.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	3.06	3.22	0.66	2.33	4.33
Back River	2.53	2.11	0.91	1.44	3.75
Loch Raven Reservoir	2.89	2.89	0.94	1.22	4.11
Jones Falls	2.19	2.56	0.89	1.00	3.44
South River/West River	3.50	3.50	2.12	2.00	5.00
Middle Patuxent River	3.33	3.67	0.64	2.11	3.89
Rocky Gorge Dam	2.96	3.00	0.20	2.56	3.22
Potomac River Lower Tidal/Potomac River Middle Tidal	3.30	4.25	1.54	1.50	4.50
Breton/St. Clements Bays	2.67	2.50	1.26	1.50	4.00
Potomac River Montgomery County	2.82	3.29	0.94	1.00	3.86
Conewago Creek/Double Pipe Creek	2.34	2.43	0.61	1.29	3.29
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	1.96	2.00	0.82	1.00	3.57
Conococheague	2.29	2.29	1.23	1.00	4.14
Savage River	2.90	3.00	1.00	1.00	3.86
Town Creek	2.32	2.00	1.34	1.00	3.86

Table B-2. Fish IBI < 3.0			
PSU	**Percentage of Stream Miles with FIBI < 3**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	50.00	9.76	90.24
Nanticoke River	55.56	25.14	83.12
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.00	0	54.93
Middle Chester River	44.44	16.88	74.86
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	37.50	11.11	71.08
Back River	55.56	25.14	83.12
Loch Raven Reservoir	50.00	22.24	77.76
Jones Falls	77.78	45.04	95.9
South River/West River	50.00	2.53	97.47
Middle Patuxent River	25.00	4.64	59.97
Rocky Gorge Dam	30.00	8.73	60.66
Potomac River Lower Tidal/Potomac River Middle Tidal	40.00	7.64	81.07
Breton/St. Clements Bays	66.67	13.54	98.3
Potomac River Montgomery County	42.86	20.61	67.5
Conewago Creek/Double Pipe Creek	94.62	58.99	97.19
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	87.50	52.93	99.36
Conococheague	70.00	39.34	91.27
Savage River	16.67	0.09	58.18
Town Creek	62.50	28.92	88.89

Table B-3. Benthic IBI

PSU	Mean	Median	Standard Dev.	Minimum	Maximum
Lower Pocomoke	1.86	1.86	0.33	1.57	2.43
Nanticoke River	2.14	2.14	0.74	1.00	3.29
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	2.80	2.57	0.76	1.86	4.43
Middle Chester River	2.43	2.43	0.63	1.29	3.29
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.44	2.33	0.60	1.86	3.67
Back River	1.89	1.86	0.28	1.57	2.33
Loch Raven Reservoir	3.41	3.67	0.85	1.89	4.56
Jones Falls	2.89	3.33	1.09	1.44	4.11
South River/West River	2.20	2.14	0.52	1.57	3.00
Middle Patuxent River	3.56	3.44	0.45	2.78	4.11
Rocky Gorge Dam	3.84	4.00	0.64	2.56	4.56
Potomac River Lower Tidal/Potomac River Middle Tidal	2.91	2.86	0.90	1.57	4.43
Breton/St. Clements Bays	3.43	3.71	1.13	1.57	4.71
Potomac River Montgomery County	3.27	3.67	0.95	1.00	4.33
Conewago Creek/Double Pipe Creek	3.51	3.67	0.70	2.56	4.56
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	3.10	3.44	0.69	1.89	4.11
Conococheague	1.96	1.67	0.65	1.44	3.44
Savage River	4.06	4.33	0.61	2.33	4.56
Town Creek	3.22	3.67	1.02	1.44	4.11

Table B-4. Benthic IBI < 3.0

PSU	Percentage of Stream Miles with BIBI < 3	Lower 90% CI	Upper 90% CI
Lower Pocomoke	100.00	74.11	100
Nanticoke River	80.00	49.31	93.32
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	70.00	39.34	91.27
Middle Chester River	80.00	49.31	96.32
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	80.00	49.31	96.32
Back River	100.00	74.11	100
Loch Raven Reservoir	29.41	12.38	51.19
Jones Falls	40.00	15	69.65
South River/West River	90.00	60.58	99.49
Middle Patuxent River	10.00	0.5	39.42
Rocky Gorge Dam	10.00	0.5	39.42
Potomac River Lower Tidal/Potomac River Middle Tidal	50.00	22.24	77.76
Breton/St. Clements Bays	30.00	8.73	60.66
Potomac River Montgomery County	26.67	9.67	51.08
Conewago Creek/Double Pipe Creek	29.41	12.38	52.19
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	38.46	16.57	64.52
Conococheague	90.00	60.58	99.49
Savage River	7.14	0.3	29.67
Town Creek	40.00	15	69.65

Table B-5. Combined Biotic Index					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	1.96	1.82	0.59	1.43	3.09
Nanticoke River	2.32	2.11	0.56	1.66	3.13
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	2.96	2.64	0.84	1.86	4.46
Middle Chester River	2.70	2.70	0.54	1.77	3.64
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.63	2.56	0.63	1.86	4.00
Back River	2.17	2.17	0.45	1.56	2.80
Loch Raven Reservoir	3.15	3.22	0.77	1.89	4.56
Jones Falls	2.63	2.83	0.96	1.22	4.11
South River/West River	2.28	2.14	0.67	1.57	3.71
Middle Patuxent River	3.46	3.50	0.40	2.78	4.11
Rocky Gorge Dam	3.40	3.56	0.35	2.78	3.78
Potomac River Lower Tidal/Potomac River Middle Tidal	2.92	2.90	0.87	1.54	4.20
Breton/St. Clements Bays	3.18	3.14	1.00	1.57	4.71
Potomac River Montgomery County	3.00	3.25	0.88	1.00	3.98
Conewago Creek/Double Pipe Creek	2.97	3.02	0.33	2.46	3.49
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.74	2.83	0.60	1.59	3.67
Conococheague	2.12	2.13	0.58	1.22	2.90
Savage River	3.77	3.89	0.69	2.33	4.56
Town Creek	2.70	2.38	0.99	1.44	3.98

Table B-6. CBI < 3.0			
PSU	**Percentage of Stream Miles with CBI < 3**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	90.00	60.58	99.49
Nanticoke River	80.00	49.31	96.32
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	70.00	39.34	91.27
Middle Chester River	80.00	49.31	96.32
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	80.00	49.31	96.32
Back River	100.00	74.11	100.00
Loch Raven Reservoir	41.18	21.19	63.60
Jones Falls	50.00	22.24	77.76
South River/West River	90.00	60.58	99.49
Middle Patuxent River	10.00	0.50	39.42
Rocky Gorge Dam	10.00	0.50	39.42
Potomac River Lower Tidal/Potomac River Middle Tidal	50.00	22.24	77.76
Breton/St. Clements Bays	40.00	15.00	69.65
Potomac River Montgomery County	33.33	14.17	57.74
Conewago Creek/Double Pipe Creek	41.18	21.19	63.60
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	69.23	42.74	88.73
Conococheague	100.00	74.11	100.00
Savage River	14.29	2.60	38.54
Town Creek	60.00	30.35	85.00

Table B-7. Spring pH < 6			
PSU	**Percentage of Stream Miles with pH < 6**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	50.00	22.24	77.76
Nanticoke River	20.00	3.68	50.69
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	10.00	0.50	39.42
Middle Chester River	10.00	0.50	39.42
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.00	0.00	25.89
Back River	0.00	0.00	25.89
Loch Raven Reservoir	0.00	0.00	16.16
Jones Falls	0.00	0.00	25.89
South River/West River	30.00	8.73	60.66
Middle Patuxent River	0.00	0.00	25.89
Rocky Gorge Dam	0.00	0.00	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	30.00	8.73	60.66
Breton/St. Clements Bays	20.00	3.68	50.63
Potomac River Montgomery County	0.00	0.00	18.10
Conewago Creek/Double Pipe Creek	0.00	0.00	16.16
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.69	0.30	31.63
Conococheague	0.00	0.00	25.89
Savage River	0.00	0.00	19.26
Town Creek	0.00	0.00	25.89

Table B-8. Summer pH					
	Mean	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	6.09	6.37	0.94	3.68	6.61
Nanticoke River	6.47	6.53	0.31	5.85	6.90
Eastern Bay/Kent Narrows/Lower Chester River/ Langford Creek/Kent Island Bay	6.72	6.76	0.47	6.00	7.65
Middle Chester River	6.94	6.87	0.77	5.36	8.45
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	7.39	7.41	0.22	6.97	7.77
Back River	7.64	7.46	0.48	7.11	8.60
Loch Raven Reservoir	7.41	7.45	0.48	6.29	7.94
Jones Falls	7.65	7.55	0.59	7.05	9.11
South River/West River	6.57	6.62	0.34	6.14	7.10
Middle Patuxent River	7.01	7.09	0.37	6.50	7.45
Rocky Gorge Dam	6.79	6.79	0.14	6.63	7.12
Potomac River Lower Tidal/Potomac River Middle Tidal	6.28	6.25	0.61	5.51	7.11
Breton/St. Clements Bays	6.61	6.80	0.46	5.72	6.95
Potomac River Montgomery County	7.27	7.26	0.39	6.69	8.10
Conewago Creek/Double Pipe Creek	7.56	7.48	0.35	7.05	8.30
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.03	7.35	1.14	4.33	8.01
Conococheague	7.76	7.73	0.23	7.40	8.06
Savage River	6.85	6.89	0.29	6.37	7.18
Town Creek	7.25	7.49	0.64	6.35	7.98

Table B-9. ANC < 50 µeq/L			
PSU	**Percentage of Stream Miles with ANC < 50 µeq/L**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	20.00	3.68	50.69
Nanticoke River	20.00	3.68	50.69
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.00	0.00	25.89
Middle Chester River	0.00	0.00	25.89
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.00	0.00	25.89
Back River	0.00	0.00	25.89
Loch Raven Reservoir	0.00	0.00	16.16
Jones Falls	0.00	0.00	25.89
South River/West River	10.00	0.50	39.42
Middle Patuxent River	0.00	0.00	25.89
Rocky Gorge Dam	0.00	0.00	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	30.00	8.73	60.66
Breton/St. Clements Bays	20.00	3.68	50.69
Potomac River Montgomery County	0.00	0.00	18.10
Conewago Creek/Double Pipe Creek	0.00	0.00	25.89
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.69	0.30	31.63
Conococheague	0.00	0.00	16.16
Savage River	0.00	0.00	19.26
Town Creek	0.00	0.00	25.89

Table B-10. ANC < 200 µeq/L			
PSU	**Perentage of Stream Miles with ANC < 200 µeq/L**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	70.00	39.34	91.27
Nanticoke River	20.00	3.68	50.69
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	20.00	3.68	50.69
Middle Chester River	10.00	0.50	39.42
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.00	0.00	25.89
Back River	0.00	0.00	25.89
Loch Raven Reservoir	0.00	0.00	16.16
Jones Falls	0.00	0.00	25.89
South River/West River	60.00	60.35	85.00
Middle Patuxent River	0.00	0.00	25.89
Rocky Gorge Dam	0.00	0.00	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	60.00	30.35	85.00
Breton/St. Clements Bays	50.00	22.24	77.76
Potomac River Montgomery County	0.00	0.00	18.10
Conewago Creek/Double Pipe Creek	0.00	0.00	25.89
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.69	0.30	31.63
Conococheague	0.00	0.00	16.16
Savage River	71.43	46.00	89.60
Town Creek	20.00	3.68	50.69

Table B-11. Physical Habitat Indicator					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	30.59	23.28	23.16	7.72	75.80
Nanticoke River	30.96	15.17	31.80	2.62	96.05
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	50.89	45.52	24.78	18.89	88.54
Middle Chester River	52.85	63.09	24.36	13.55	89.09
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	45.24	46.27	30.32	6.88	96.48
Back River	17.71	17.77	8.33	5.36	34.51
Loch Raven Reservoir	52.19	46.23	34.79	2.86	100.00
Jones Falls	44.07	36.38	37.61	0.45	99.97
South River/West River	22.76	11.50	23.37	4.36	68.54
Middle Patuxent River	58.81	65.20	29.13	1.80	97.11
Rocky Gorge Dam	75.77	83.43	27.64	6.88	99.32
Potomac River Lower Tidal/Potomac River Middle Tidal	49.20	59.44	36.85	4.46	90.31
Breton/St. Clements Bays	50.52	52.94	29.98	4.27	86.63
Potomac River Montgomery County	57.32	59.45	30.87	6.13	97.53
Conewago Creek/Double Pipe Creek	44.37	46.78	28.58	1.47	88.66
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	39.28	19.49	37.59	3.48	93.04
Conococheague	35.04	21.35	31.81	1.95	96.68
Savage River	67.06	76.88	26.73	15.65	98.14
Town Creek	51.63	61.42	39.47	4.32	91.59

Table B-12. PHI < 42			
PSU	**Percentage of Stream Miles with PHI < 42**	**Lower 90% CI**	**Upper 90%**
Lower Pocomoke	77.78	45.04	95.90
Nanticoke River	66.67	34.49	90.23
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	22.22	4.10	54.96
Middle Chester River	33.33	9.77	65.51
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	33.33	9.77	65.51
Back River	100.00	74.11	100.00
Loch Raven Reservoir	43.75	22.67	66.66
Jones Falls	55.56	25.14	83.12
South River/West River	77.78	45.04	95.90
Middle Patuxent River	20.00	8.73	60.66
Rocky Gorge Dam	10.00	0.50	39.42
Potomac River Lower Tidal/Potomac River Middle Tidal	42.86	12.88	77.47
Breton/St. Clements Bays	33.33	6.28	72.87
Potomac River Montgomery County	28.57	10.40	54.00
Conewago Creek/Double Pipe Creek	46.67	24.37	70.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	55.56	25.14	83.12
Conococheague	60.00	30.35	85.00
Savage River	15.38	2.81	41.01
Town Creek	50.00	19.29	80.71

Table B-13. Channelized			
PSU	**Percentage of Stream Miles Channelized**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	70.00	39.34	91.27
Nanticoke River	80.00	49.31	96.32
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.00	0.00	25.89
Middle Chester River	0.00	0.00	25.89
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	50.00	22.24	77.76
Back River	50.00	22.24	77.76
Loch Raven Reservoir	11.76	2.13	32.62
Jones Falls	30.00	8.73	60.66
South River/West River	0.00	0.00	25.89
Middle Patuxent River	20.00	3.68	50.69
Rocky Gorge Dam	0.00	0.00	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	0.00	0.00	25.89
Breton/St. Clements Bays	0.00	0.00	25.89
Potomac River Montgomery County	6.67	0.34	27.94
Conewago Creek/Double Pipe Creek	5.88	0.30	25.01
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	23.08	6.60	49.46
Conococheague	10.00	0.50	39.42
Savage River	0.00	0.00	19.26
Town Creek	20.00	3.68	50.69

Table B-14. Moderate to Severe Bank Erosion			
PSU	**Percentage of Stream Miles with Moderate to Severe Bank Erosion**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	0.00	0.00	28.31
Nanticoke River	0.00	0.00	28.31
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	33.33	9.77	65.61
Middle Chester River	30.00	8.73	60.66
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	33.33	9.77	65.61
Back River	60.00	30.35	85.00
Loch Raven Reservoir	68.75	45.17	86.79
Jones Falls	66.67	34.49	90.23
South River/West River	55.56	25.14	83.12
Middle Patuxent River	50.00	22.24	77.76
Rocky Gorge Dam	100.00	74.11	100.00
Potomac River Lower Tidal/Potomac River Middle Tidal	71.43	34.13	94.66
Breton/St. Clements Bays	50.00	15.32	84.68
Potomac River Montgomery County	42.86	20.61	67.50
Conewago Creek/Double Pipe Creek	66.66	42.26	85.83
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	11.11	0.57	42.91
Conococheague	20.00	3.68	50.69
Savage River	7.69	0.30	31.63
Town Creek	25.00	4.64	59.97

Table B-15. Moderate to Severe Bar Formation			
PSU	**Percentage of Stream Miles with Moderate to Severe Bar Formation**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	33.33	9.77	65.51
Nanticoke River	22.72	4.1	54.96
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	44.44	16.88	74.86
Middle Chester River	30	8.73	60.66
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	55.56	25.14	83.12
Back River	100	74.11	100
Loch Raven Reservoir	43.75	22.67	66.66
Jones Falls	55.56	25.14	83.12
South River/West River	44.44	16.88	74.86
Middle Patuxent River	40	15	69.65
Rocky Gorge Dam	50	22.24	77.76
Potomac River Lower Tidal/Potomac River Middle Tidal	42.86	12.88	77.47
Breton/St. Clements Bays	83.33	41.82	99.15
Potomac River Montgomery County	64.29	39.04	84.73
Conewago Creek/Double Pipe Creek	40	19.09	64.04
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	22.72	4.1	54.96
Conococheague	20	3.68	50.69
Savage River	38.46	16.57	64.52
Town Creek	12.5	0.64	47.07

Table B-16. No Riparian Buffer on at Least One Bank			
PSU	**Percentage of Stream Miles with No Riparian Buffer on at Least One Bank**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	50	22.24	77.76
Nanticoke River	10	0.5	39.42
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0	0	25.89
Middle Chester River	0	0	25.89
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0	0	25.89
Back River	10	0.5	39.42
Loch Raven Reservoir	17.65	4.9	39.56
Jones Falls	10	0.5	39.42
South River/West River	10	0.5	39.42
Middle Patuxent River	20	3.68	50.69
Rocky Gorge Dam	10	0.5	39.42
Potomac River Lower Tidal/Potomac River Middle Tidal	0	0	25.89
Breton/St. Clements Bays	0	0	25.89
Potomac River Montgomery County	13.33	2.42	36.64
Conewago Creek/Double Pipe Creek	23.58	8.46	46.05
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	30.77	11.27	57.26
Conococheague	30	8.73	60.66
Savage River	0	0	19.26
Town Creek	20	3.68	50.69

Table B-17. No Riparian Buffer on Both Banks			
PSU	**Percentage of Stream Miles with No Riparian Buffer Both Banks**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	30	8.73	60.66
Nanticoke River	0	0	25.89
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0	0.00	25.89
Middle Chester River	0	0	25.89
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0	0.00	25.89
Back River	10	0.5	39.42
Loch Raven Reservoir	17.65	4.90	39.56
Jones Falls	10	0.5	39.42
South River/West River	10	0.05	39.42
Middle Patuxent River	10	0.5	39.42
Rocky Gorge Dam	0	0.00	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	0	0.00	25.89
Breton/St. Clements Bays	0	0	25.89
Potomac River Montgomery County	6.67	0.30	27.97
Conewago Creek/Double Pipe Creek	23.58	8.46	46.05
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	30.77	11.27	57.26
Conococheague	30	8.73	60.66
Savage River	0	0.00	19.26
Town Creek	10	0.5	39.42

Table B-18. Extensive exotic plants			
PSU	**Percentage of Stream Miles with Exotic Plants Present**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	0	0	28.31
Nanticoke River	0	0	28.31
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	11.11	0.5	42.91
Middle Chester River	0	0	25.89
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0	0	28.31
Back River	0	0	25.89
Loch Raven Reservoir	0	0	17.07
Jones Falls	11.11	0.5	42.91
South River/West River	11.11	0.5	42.91
Middle Patuxent River	0	0	25.89
Rocky Gorge Dam	0	0	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	14.29	0.7	52.07
Breton/St. Clements Bays	16.67	0.8	58.18
Potomac River Montgomery County	0	0	19.26
Conewago Creek/Double Pipe Creek	0	0	18.1
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	0	0	28.31
Conococheague	0	0	25.89
Savage River	53.85	28.7	77.6
Town Creek	25	4.64	59.97

Table B-19. Total Number of Rootwads and Woody Debris					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	3.56	2.00	3.68	0.00	10.00
Nanticoke River	5.33	4.00	4.12	0.00	14.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	5.33	6.00	4.39	0.00	12.00
Middle Chester River	5.56	5.00	5.43	0.00	17.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.78	3.00	2.33	0.00	5.00
Back River	2.40	2.50	2.17	0.00	6.00
Loch Raven Reservoir	5.06	3.50	6.33	0.00	26.00
Jones Falls	5.22	1.00	8.54	0.00	26.00
South River/West River	3.00	3.00	2.40	0.00	7.00
Middle Patuxent River	3.30	3.50	3.02	0.00	9.00
Rocky Gorge Dam	6.80	5.50	4.47	0.00	14.00
Potomac River Lower Tidal/Potomac River Middle Tidal	6.00	5.00	5.45	0.00	15.00
Breton/St. Clements Bays	5.50	6.50	4.42	0.00	10.00
Potomac River Montgomery County	3.71	3.50	2.79	0.00	9.00
Conewago Creek/Double Pipe Creek	2.93	2.00	4.03	0.00	16.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	3.44	2.00	3.94	0.00	11.00
Conococheague	3.30	2.00	3.86	0.00	10.00
Savage River	2.62	1.00	3.86	0.00	11.00
Town Creek	2.38	2.50	1.77	0.00	5.00

Table B-20. Total Number of Instream Woody Debris					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	2.56	2.00	2.30	0.00	6.00
Nanticoke River	4.11	3.00	3.02	0.00	9.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	3.33	3.00	3.04	0.00	8.00
Middle Chester River	4.33	2.00	4.82	0.00	14.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	1.67	1.00	2.06	0.00	5.00
Back River	0.80	0.50	1.03	0.00	3.00
Loch Raven Reservoir	3.44	1.50	6.35	0.00	26.00
Jones Falls	3.00	0.00	6.22	0.00	19.00
South River/West River	2.56	2.00	2.07	0.00	6.00
Middle Patuxent River	2.10	1.00	2.77	0.00	8.00
Rocky Gorge Dam	5.40	3.50	4.58	0.00	13.00
Potomac River Lower Tidal/Potomac River Middle Tidal	3.86	1.00	4.81	0.00	12.00
Breton/St. Clements Bays	2.00	2.00	1.90	0.00	4.00
Potomac River Montgomery County	2.43	2.00	2.21	0.00	8.00
Conewago Creek/Double Pipe Creek	1.40	1.00	1.45	0.00	4.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.11	1.00	2.89	0.00	7.00
Conococheague	2.00	1.50	2.11	0.00	6.00
Savage River	1.69	1.00	2.81	0.00	10.00
Town Creek	1.63	2.00	1.41	0.00	3.00

Table B-21. Total Number of Dewatered Woody Debris					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	2.00	0.00	3.35	0.00	10.00
Nanticoke River	3.22	3.00	2.54	0.00	9.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	6.11	6.00	3.82	0.00	14.00
Middle Chester River	7.22	4.00	8.79	0.00	29.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	3.44	2.00	3.40	0.00	9.00
Back River	1.80	2.00	1.48	0.00	5.00
Loch Raven Reservoir	3.63	2.00	3.42	0.00	12.00
Jones Falls	4.56	3.00	4.33	0.00	13.00
South River/West River	5.11	6.00	3.52	0.00	10.00
Middle Patuxent River	3.50	2.00	2.68	1.00	7.00
Rocky Gorge Dam	6.60	6.00	3.69	0.00	13.00
Potomac River Lower Tidal/Potomac River Middle Tidal	5.43	5.00	3.51	2.00	11.00
Breton/St. Clements Bays	3.17	2.50	1.94	1.00	6.00
Potomac River Montgomery County	3.79	2.50	3.42	0.00	12.00
Conewago Creek/Double Pipe Creek	5.33	4.00	4.90	1.00	16.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.40	1.00	3.96	0.00	14.00
Conococheague	3.10	2.00	3.48	0.00	10.00
Savage River	8.38	7.00	4.17	4.00	16.00
Town Creek	5.38	3.50	4.37	1.00	13.00

Table B-22. Total Number of Woody Debris					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	4.56	4.00	5.17	0.00	16.00
Nanticoke River	7.33	6.00	4.12	2.00	15.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	9.25	8.50	5.55	0.00	20.00
Middle Chester River	11.56	6.00	13.19	2.00	43.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	5.70	4.00	5.42	0.00	14.00
Back River	2.60	2.00	1.78	0.00	5.00
Loch Raven Reservoir	7.06	5.50	8.25	0.00	34.00
Jones Falls	7.56	6.00	9.77	0.00	32.00
South River/West River	7.67	10.00	4.85	0.00	14.00
Middle Patuxent River	5.60	6.00	4.06	1.00	15.00
Rocky Gorge Dam	12.00	10.00	7.47	3.00	24.00
Potomac River Lower Tidal/Potomac River Middle Tidal	9.29	9.00	7.20	2.00	20.00
Breton/St. Clements Bays	5.17	4.50	3.54	2.00	9.00
Potomac River Montgomery County	6.21	4.50	4.42	0.00	14.00
Conewago Creek/Double Pipe Creek	3.80	2.00	5.05	0.00	18.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.44	8.00	4.13	2.00	16.00
Conococheague	5.10	3.50	5.02	0.00	13.00
Savage River	10.08	8.00	6.14	4.00	26.00
Town Creek	7.00	5.00	3.78	4.00	13.00

Table B-23. Total Number of Instream Rootwads					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	1.00	0.00	2.00	0.00	6.00
Nanticoke River	1.22	0.00	1.72	0.00	5.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	2.00	1.00	2.45	0.00	7.00
Middle Chester River	1.22	1.00	1.48	0.00	4.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	1.11	0.00	1.45	0.00	3.00
Back River	1.60	1.00	1.71	0.00	5.00
Loch Raven Reservoir	1.63	1.00	1.71	0.00	5.00
Jones Falls	2.22	0.00	2.77	0.00	7.00
South River/West River	0.44	0.00	0.73	0.00	2.00
Middle Patuxent River	1.20	1.00	1.32	0.00	4.00
Rocky Gorge Dam	1.40	2.00	1.07	0.00	3.00
Potomac River Lower Tidal/Potomac River Middle Tidal	2.14	3.00	1.77	0.00	4.00
Breton/St. Clements Bays	3.50	3.00	3.27	0.00	8.00
Potomac River Montgomery County	1.29	1.00	1.64	0.00	6.00
Conewago Creek/Double Pipe Creek	1.53	1.00	2.97	0.00	12.00
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway	1.33	1.00	1.58	0.00	4.00
Conococheague	1.30	0.50	1.83	0.00	5.00
Savage River	0.92	0.00	2.14	0.00	7.00
Town Creek	0.75	0.00	1.16	0.00	3.00

Table B-24. Total Number of Dewatered Rootwads					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	5.00	3.00	5.63	0.00	15.00
Nanticoke River	10.44	7.00	10.21	2.00	36.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	4.00	4.00	3.57	0.00	11.00
Middle Chester River	3.56	3.00	3.17	0.00	8.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	6.11	8.00	3.66	0.00	10.00
Back River	6.80	4.50	6.34	0.00	16.00
Loch Raven Reservoir	6.31	4.50	8.60	0.00	37.00
Jones Falls	5.56	5.00	4.16	0.00	12.00
South River/West River	4.67	4.00	3.08	2.00	12.00
Middle Patuxent River	5.80	4.50	3.43	2.00	13.00
Rocky Gorge Dam	6.90	5.50	4.68	2.00	19.00
Potomac River Lower Tidal/Potomac River Middle Tidal	7.57	7.00	4.16	3.00	13.00
Breton/St. Clements Bays	9.83	6.50	8.38	3.00	25.00
Potomac River Montgomery County	5.00	5.00	2.72	0.00	11.00
Conewago Creek/Double Pipe Creek	5.00	3.00	6.85	0.00	25.00
Potomac River Washington County/Marsh Run/Tonoloway/Little Tonoloway	5.89	6.00	3.30	0.00	12.00
Conococheague	5.00	5.50	5.06	0.00	17.00
Savage River	11.77	9.00	7.57	3.00	30.00
Town Creek	7.13	5.50	6.90	0.00	18.00

Table B-25. Total Number of Rootwads					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	6.00	3.00	6.34	0.00	16.00
Nanticoke River	11.67	9.00	9.59	4.00	36.00
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	6.00	5.00	5.00	0.00	14.00
Middle Chester River	4.78	5.00	3.03	0.00	8.00
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	7.22	8.00	3.31	0.00	11.00
Back River	8.40	7.00	6.26	0.00	16.00
Loch Raven Reservoir	7.94	6.00	9.45	0.00	41.00
Jones Falls	7.78	7.00	5.43	0.00	19.00
South River/West River	5.11	4.00	3.02	3.00	12.00
Middle Patuxent River	7.00	6.50	3.92	2.00	13.00
Rocky Gorge Dam	8.30	7.00	4.45	4.00	19.00
Potomac River Lower Tidal/Potomac River Middle Tidal	9.71	11.00	3.55	4.00	13.00
Breton/St. Clements Bays	13.33	12.00	6.59	5.00	25.00
Potomac River Montgomery County	6.29	6.50	2.97	0.00	11.00
Conewago Creek/Double Pipe Creek	6.53	4.00	8.55	0.00	26.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.22	8.00	3.03	3.00	12.00
Conococheague	6.30	6.50	6.00	0.00	19.00
Savage River	12.69	12.00	7.43	3.00	30.00
Town Creek	7.88	6.00	6.94	0.00	18.00

Table B-26. Total Nitrogen (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	1.90	0.80	3.27	0.24	11.04
Nanticoke River	4.26	3.26	4.07	0.51	12.19
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	2.87	2.90	1.73	0.73	5.23
Middle Chester River	4.65	4.99	2.31	0.64	7.73
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.13	1.86	1.46	0.49	4.84
Back River	1.37	1.42	0.32	0.88	1.82
Loch Raven Reservoir	3.19	2.72	1.46	0.52	5.92
Jones Falls	1.98	1.94	0.94	0.74	4.33
South River/West River	0.61	0.72	0.31	0.22	0.99
Middle Patuxent River	2.28	2.13	0.60	1.50	3.59
Rocky Gorge Dam	2.34	2.09	0.57	1.64	3.31
Potomac River Lower Tidal/Potomac River Middle Tidal	0.39	0.29	0.45	0.10	1.60
Breton/St. Clements Bays	0.36	0.26	0.30	0.13	1.16
Potomac River Montgomery County	1.45	1.44	0.76	0.46	3.24
Conewago Creek/Double Pipe Creek	4.00	3.83	2.68	1.25	13.48
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	1.47	0.67	1.55	0.24	5.48
Conococheague	5.85	5.88	2.95	0.53	12.13
Savage River	1.25	0.96	0.85	0.64	3.83
Town Creek	0.48	0.30	0.47	0.14	1.76

Table B-27. Nitrate Nitrogen (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	1.55	0.40	3.37	0.00	11.04
Nanticoke River	3.93	3.03	4.26	0.03	12.02
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	2.04	1.17	2.11	0.09	5.14
Middle Chester River	3.99	3.97	2.28	0.00	7.52
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.00	1.71	1.53	0.23	4.78
Back River	1.22	1.33	0.34	0.69	1.73
Loch Raven Reservoir	2.97	2.69	1.38	0.42	5.80
Jones Falls	1.89	1.85	0.93	0.60	4.15
South River/West River	0.75	0.49	1.08	0.13	3.91
Middle Patuxent River	2.13	1.97	0.66	1.19	3.60
Rocky Gorge Dam	2.23	1.94	0.57	1.58	3.15
Potomac River Lower Tidal/Potomac River Middle Tidal	0.22	0.07	0.47	0.00	1.55
Breton/St. Clements Bays	0.22	0.12	0.31	0.00	1.04
Potomac River Montgomery County	1.40	1.49	0.74	0.58	3.08
Conewago Creek/Double Pipe Creek	3.25	3.58	1.10	1.18	4.65
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	1.41	0.61	1.56	0.18	5.51
Conococheague	5.56	5.45	2.83	0.33	11.36
Savage River	1.19	0.88	0.86	0.60	3.82
Town Creek	0.40	0.23	0.46	0.08	1.64

Table B-28. Nitrite Nitrogen (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	0.0063	0.0065	0.0052	0.0004	0.0148
Nanticoke River	0.0075	0.0062	0.0034	0.0022	0.0133
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.0199	0.0198	0.0150	0.0038	0.0477
Middle Chester River	0.0324	0.0299	0.0249	0.0006	0.0790
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.0051	0.0038	0.0052	0.0008	0.0194
Back River	0.0092	0.0094	0.0030	0.0043	0.0142
Loch Raven Reservoir	0.0134	0.0082	0.0125	0.0006	0.0493
Jones Falls	0.0109	0.0089	0.0097	0.0021	0.0285
South River/West River	0.0067	0.0049	0.0041	0.0021	0.0161
Middle Patuxent River	0.0100	0.0101	0.0039	0.0029	0.0184
Rocky Gorge Dam	0.0097	0.0096	0.0031	0.0059	0.0133
Potomac River Lower Tidal/Potomac River Middle Tidal	0.0021	0.0023	0.0014	0.0004	0.0045
Breton/St. Clements Bays	0.0031	0.0038	0.0020	0.0004	0.0057
Potomac River Montgomery County	0.0071	0.0052	0.0089	0.0004	0.0378
Conewago Creek/Double Pipe Creek	0.0257	0.0119	0.0418	0.0018	0.1700
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	0.0040	0.0015	0.0060	0.0004	0.0217
Conococheague	0.0318	0.0247	0.0326	0.0021	0.1110
Savage River	0.0019	0.0009	0.0031	0.0004	0.0127
Town Creek	0.0018	0.0016	0.0016	0.0004	0.0056

Table B-29. Ammonia (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	0.0432	0.0277	0.0424	0.0083	0.1472
Nanticoke River	0.0389	0.0229	0.0368	0.0054	0.1247
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.3170	0.0504	0.8653	0.0197	2.7790
Middle Chester River	0.1180	0.0686	0.1282	0.0164	0.4239
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.0314	0.0200	0.0317	0.0043	0.1031
Back River	0.0249	0.0196	0.0179	0.0069	0.0559
Loch Raven Reservoir	0.0561	0.0208	0.1038	0.0088	0.4265
Jones Falls	0.0192	0.0105	0.0156	0.0047	0.0507
South River/West River	0.0869	0.0573	0.0746	0.0188	0.2449
Middle Patuxent River	0.0365	0.0267	0.0319	0.0058	0.0857
Rocky Gorge Dam	0.0296	0.0295	0.0182	0.0084	0.0697
Potomac River Lower Tidal/Potomac River Middle Tidal	0.0357	0.0246	0.0407	0.0047	0.1407
Breton/St. Clements Bays	0.0214	0.0177	0.0094	0.0108	0.0411
Potomac River Montgomery County	0.0124	0.0113	0.0072	0.0035	0.0316
Conewago Creek/Double Pipe Creek	0.5266	0.0107	1.9164	0.0052	7.9438
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	0.0137	0.0078	0.0126	0.0042	0.0466
Conococheague	0.0612	0.0264	0.0924	0.0057	0.3109
Savage River	0.0046	0.0042	0.0027	0.0020	0.0106
Town Creek	0.0065	0.0044	0.0047	0.0027	0.0187

Table B-30. Nitrate nitrogen > 1 mg/L			
PSU	**Percentage of Stream Miles with NO3 > 1 mg/L**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	30	8.73	60.66
Nanticoke River	50	22.24	77.76
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	50	22.24	77.76
Middle Chester River	90	60.58	99.49
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	70	39.34	91.27
Back River	80	49.31	96.32
Loch Raven Reservoir	94.12	74.99	99.7
Jones Falls	90	60.58	99.49
South River/West River	0	0	25.89
Middle Patuxent River	100	74.11	100
Rocky Gorge Dam	100	74.11	100
Potomac River Lower Tidal/Potomac River Middle Tidal	10	0.5	39.42
Breton/St. Clements Bays	10	0.5	39.42
Potomac River Montgomery County	53.33	30	75.63
Conewago Creek/Double Pipe Creek	100	83.84	100
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	38.46	16.57	64.52
Conococheague	90	60.58	99.49
Savage River	35.71	15.27	60.96
Town Creek	10	0.5	39.42

Table B-31. Total phosphorus (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	0.0782	0.0637	0.0628	0.0100	0.1844
Nanticoke River	0.0475	0.0196	0.0619	0.0061	0.1915
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.1244	0.0995	0.1040	0.0106	0.3643
Middle Chester River	0.2324	0.0878	0.3512	0.0228	1.0372
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.0363	0.0197	0.0516	0.0120	0.1820
Back River	0.0463	0.0157	0.0775	0.0087	0.2625
Loch Raven Reservoir	0.0815	0.0200	0.1522	0.0061	0.5196
Jones Falls	0.0247	0.0244	0.0102	0.0089	0.0443
South River/West River	0.0864	0.0770	0.0590	0.0144	0.1948
Middle Patuxent River	0.0278	0.0191	0.0224	0.0082	0.0849
Rocky Gorge Dam	0.0360	0.0301	0.0228	0.0118	0.0935
Potomac River Lower Tidal/Potomac River Middle Tidal	0.0346	0.0116	0.0476	0.0047	0.1326
Breton/St. Clements Bays	0.0288	0.0233	0.0191	0.0078	0.0736
Potomac River Montgomery County	0.0294	0.0187	0.0278	0.0056	0.1126
Conewago Creek/Double Pipe Creek	0.1386	0.0252	0.3462	0.0072	1.4254
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	0.0134	0.0098	0.0088	0.0043	0.0323
Conococheague	0.0998	0.0716	0.0990	0.0134	0.3513
Savage River	0.0130	0.0108	0.0065	0.0052	0.0273
Town Creek	0.0119	0.0103	0.0080	0.0044	0.0314

Table B-32. Orthophosphate (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	0.0096	0.0082	0.0085	0.0007	0.0241
Nanticoke River	0.0050	0.0028	0.0053	0.0007	0.0134
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.0179	0.0090	0.0209	0.0007	0.0673
Middle Chester River	0.0859	0.0085	0.1701	0.0041	0.4918
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0.0077	0.0054	0.0068	0.0007	0.0201
Back River	0.0188	0.0016	0.0488	0.0007	0.1571
Loch Raven Reservoir	0.0096	0.0032	0.0145	0.0007	0.0569
Jones Falls	0.0077	0.0044	0.0064	0.0007	0.0193
South River/West River	0.0059	0.0007	0.0078	0.0007	0.0197
Middle Patuxent River	0.0041	0.0038	0.0028	0.0007	0.0105
Rocky Gorge Dam	0.0089	0.0034	0.0186	0.0007	0.0615
Potomac River Lower Tidal/Potomac River Middle Tidal	0.0033	0.0007	0.0049	0.0007	0.0162
Breton/St. Clements Bays	0.0055	0.0037	0.0063	0.0007	0.0202
Potomac River Montgomery County	0.0084	0.0042	0.0098	0.0007	0.0346
Conewago Creek/Double Pipe Creek	0.0764	0.0045	0.2184	0.0007	0.8861
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	0.0016	0.0007	0.0012	0.0007	0.0036
Conococheague	0.0232	0.0073	0.0440	0.0007	0.1433
Savage River	0.0051	0.0046	0.0042	0.0007	0.0138
Town Creek	0.0011	0.0007	0.0013	0.0007	0.0049

Table B-33. Dissolved Oxygen (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	5.66	5.40	1.62	3.60	8.20
Nanticoke River	6.46	6.30	1.71	4.10	8.80
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	4.82	5.00	2.10	2.10	7.80
Middle Chester River	6.67	6.85	1.68	2.90	9.40
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	7.18	7.50	0.94	5.80	8.70
Back River	6.99	6.80	2.44	2.20	10.80
Loch Raven Reservoir	7.28	7.50	1.79	3.20	10.70
Jones Falls	8.69	8.80	4.39	0.70	17.90
South River/West River	6.17	6.80	1.82	3.50	8.80
Middle Patuxent River	7.02	7.10	1.11	4.60	8.40
Rocky Gorge Dam	6.24	6.15	0.74	5.30	7.60
Potomac River Lower Tidal/Potomac River Middle Tidal	3.51	2.60	2.59	0.60	6.90
Breton/St. Clements Bays	4.68	4.85	1.96	2.30	6.80
Potomac River Montgomery County	8.21	8.50	1.29	5.60	9.90
Conewago Creek/Double Pipe Creek	6.95	7.50	1.93	3.50	10.60
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	7.96	7.70	2.20	4.20	10.90
Conococheague	7.57	7.95	1.88	4.90	9.80
Savage River	9.48	9.40	1.49	6.60	12.80
Town Creek	7.77	7.60	1.73	4.90	10.50

Table B-34. Dissolved oxygen < 5 mg/L			
PSU	**Percentage of Stream Miles with DO < 5 mg/L**	**Lower 90% CI**	**Upper 90% CI**
Lower Pocomoke	44.44	16.88	74.86
Nanticoke River	22.22	4.1	54.96
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	44.44	16.88	74.86
Middle Chester River	10	0.5	39.42
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	0	0	28.31
Back River	10	0.5	39.42
Loch Raven Reservoir	12.5	2.27	34.38
Jones Falls	11.11	0.5	42.97
South River/West River	44.44	16.88	74.86
Middle Patuxent River	10	0.5	39.42
Rocky Gorge Dam	0	0	25.89
Potomac River Lower Tidal/Potomac River Middle Tidal	71.43	34.13	94.66
Breton/St. Clements Bays	50	15.32	84.68
Potomac River Montgomery County	0	0	19.26
Conewago Creek/Double Pipe Creek	20	5.68	43.98
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	11.11	0.5	42.91
Conococheague	20	3.68	50.69
Savage River	0	0	20.58
Town Creek	12.5	0.6	47.07

Table B-35. Turbidity (NTUs)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	25.42	19.50	24.87	0.60	82.40
Nanticoke River	4.32	4.80	2.44	1.60	8.90
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	14.82	11.70	11.69	4.00	40.20
Middle Chester River	8.96	7.35	4.91	2.70	16.20
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	1.81	1.20	1.70	0.10	4.30
Back River	2.79	1.90	2.71	0.00	6.70
Loch Raven Reservoir	18.15	2.65	54.58	0.90	222.00
Jones Falls	6.17	3.80	10.36	0.00	33.00
South River/West River	19.12	12.70	16.31	3.60	49.10
Middle Patuxent River	2.60	2.20	1.34	1.40	4.80
Rocky Gorge Dam	10.36	10.45	4.49	1.10	17.40
Potomac River Lower Tidal/Potomac River Middle Tidal	14.16	16.40	7.66	3.80	24.60
Breton/St. Clements Bays	14.88	6.90	19.14	2.40	52.20
Potomac River Montgomery County	4.39	3.40	2.69	1.10	9.90
Conewago Creek/Double Pipe Creek	8.29	7.00	5.64	0.10	22.10
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.81	2.90	1.92	0.20	6.50
Conococheague	55.69	13.45	86.94	4.00	249.00
Savage River	2.67	1.80	2.04	0.90	8.00
Town Creek	4.01	2.85	3.64	0.20	11.60

Table B-36. Sulfate (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	64.25	66.56	18.55	23.42	90.24
Nanticoke River	14.18	12.69	8.21	0.75	31.27
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	14.18	9.47	12.63	2.76	39.15
Middle Chester River	8.34	7.65	4.38	3.45	15.63
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	18.57	17.47	9.71	7.49	34.56
Back River	33.08	32.30	8.47	24.78	53.53
Loch Raven Reservoir	9.92	8.44	6.27	3.89	27.91
Jones Falls	16.68	14.35	12.22	4.94	35.03
South River/West River	19.24	18.07	11.64	3.16	36.62
Middle Patuxent River	9.25	8.79	3.67	3.10	14.92
Rocky Gorge Dam	5.39	5.78	1.83	1.70	7.87
Potomac River Lower Tidal/Potomac River Middle Tidal	9.81	7.40	6.40	4.30	23.75
Breton/St. Clements Bays	7.77	7.63	3.20	2.14	11.83
Potomac River Montgomery County	16.89	14.02	13.13	5.89	50.76
Conewago Creek/Double Pipe Creek	14.11	10.06	9.59	5.63	41.96
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	39.84	20.86	76.57	8.04	292.94
Conococheague	49.69	41.80	30.78	25.89	135.14
Savage River	12.34	12.90	1.57	8.68	14.79
Town Creek	30.95	22.45	25.89	13.32	100.34

Table B-37. Chloride (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	25.23	26.41	5.76	13.03	31.28
Nanticoke River	16.03	15.32	5.55	8.05	27.38
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	18.63	18.18	6.33	8.88	27.09
Middle Chester River	26.68	20.73	22.06	10.43	87.24
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	53.71	37.86	43.87	6.94	148.92
Back River	97.66	93.78	35.69	46.16	160.54
Loch Raven Reservoir	39.34	28.37	38.06	13.18	177.01
Jones Falls	68.91	58.94	54.01	5.07	190.39
South River/West River	45.51	51.53	22.79	6.25	79.16
Middle Patuxent River	82.74	35.70	160.28	15.61	538.20
Rocky Gorge Dam	17.71	18.31	6.51	7.52	24.41
Potomac River Lower Tidal/Potomac River Middle Tidal	11.63	8.41	7.01	5.24	24.80
Breton/St. Clements Bays	10.59	10.94	4.26	5.24	18.13
Potomac River Montgomery County	40.57	22.21	47.05	8.12	174.19
Conewago Creek/Double Pipe Creek	29.46	22.72	22.90	6.49	95.27
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	52.99	24.70	63.57	8.24	246.65
Conococheague	85.79	81.68	21.11	58.12	129.89
Savage River	7.21	4.07	7.47	1.01	26.91
Town Creek	4.47	4.29	2.91	1.41	9.76

Table B-38. Dissolved Organic Carbon (mg/L)					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	7.23	8.20	3.51	1.46	11.43
Nanticoke River	6.11	3.25	5.93	0.87	17.28
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	8.60	4.22	8.08	1.60	22.64
Middle Chester River	4.81	4.72	2.50	2.05	9.03
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	2.36	2.16	1.13	1.17	4.86
Back River	3.08	3.10	0.67	1.50	4.02
Loch Raven Reservoir	1.91	1.75	0.69	1.04	3.72
Jones Falls	2.71	1.93	2.17	1.06	8.29
South River/West River	1.92	1.84	1.01	0.58	3.31
Middle Patuxent River	2.47	1.94	0.97	1.51	4.08
Rocky Gorge Dam	2.88	2.45	1.10	1.24	4.65
Potomac River Lower Tidal/Potomac River Middle Tidal	4.17	4.12	1.71	1.95	7.65
Breton/St. Clements Bays	3.61	3.51	0.80	2.44	4.75
Potomac River Montgomery County	4.22	3.38	3.08	1.56	13.38
Conewago Creek/Double Pipe Creek	3.25	1.66	5.05	1.01	22.00
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.27	2.23	0.69	1.15	3.79
Conococheague	3.39	3.29	1.28	1.61	5.06
Savage River	1.20	1.25	0.30	0.71	1.56
Town Creek	2.16	2.10	0.41	1.64	2.99

Table B-39. Percentage Urban Land					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	0.16	0.03	0.25	0.00	0.61
Nanticoke River	2.36	1.92	2.53	0.00	6.18
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	0.95	0.79	0.70	0.34	2.68
Middle Chester River	1.36	0.95	1.09	0.34	3.80
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	26.95	6.34	31.43	0.32	78.81
Back River	73.34	74.72	10.20	59.55	89.05
Loch Raven Reservoir	7.81	0.12	17.07	0.00	48.57
Jones Falls	30.25	17.16	30.83	0.14	77.70
South River/West River	8.33	5.98	8.01	0.31	26.62
Middle Patuxent River	3.58	3.31	3.73	0.00	13.21
Rocky Gorge Dam	2.80	2.26	2.75	0.00	7.83
Potomac River Lower Tidal/Potomac River Middle Tidal	2.90	1.55	3.58	0.00	11.30
Breton/St. Clements Bays	6.15	3.72	7.14	0.00	19.16
Potomac River Montgomery County	8.80	0.39	18.29	0.00	60.09
Conewago Creek/Double Pipe Creek	0.99	0.69	1.12	0.00	4.65
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	2.72	1.78	3.24	0.00	9.90
Conococheague	7.54	5.76	6.64	0.06	23.48
Savage River	0.21	0.12	0.24	0.00	0.79
Town Creek	0.06	0.02	0.11	0.00	0.37

Table B-40. Percentage Agricultural Land					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	43.60	44.49	12.35	21.72	59.69
Nanticoke River	69.33	71.86	8.59	50.54	79.65
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	74.06	76.50	14.46	40.20	88.30
Middle Chester River	84.88	85.59	4.99	74.62	92.86
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	42.30	41.52	25.73	4.80	75.08
Back River	11.66	12.26	6.14	2.15	18.67
Loch Raven Reservoir	54.67	62.79	29.14	4.80	89.22
Jones Falls	25.22	25.04	14.23	4.05	44.24
South River/West River	46.17	47.64	27.44	5.84	97.25
Middle Patuxent River	67.13	63.60	9.77	55.99	87.60
Rocky Gorge Dam	62.67	61.57	11.06	44.46	80.84
Potomac River Lower Tidal/Potomac River Middle Tidal	15.74	11.46	14.76	1.16	49.34
Breton/St. Clements Bays	24.75	19.26	15.87	5.60	55.87
Potomac River Montgomery County	45.08	57.71	26.01	6.85	81.48
Conewago Creek/Double Pipe Creek	74.95	78.58	15.87	37.29	93.37
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	27.68	11.86	27.01	2.97	78.30
Conococheague	79.98	81.64	13.48	58.81	96.67
Savage River	19.11	10.40	19.07	1.54	55.94
Town Creek	15.46	14.51	9.57	0.00	38.53

Table B-41. Percentage Forested Land					
PSU	**Mean**	**Median**	**Standard Dev.**	**Minimum**	**Maximum**
Lower Pocomoke	53.98	51.51	10.91	40.06	70.18
Nanticoke River	27.81	23.21	9.86	19.58	47.42
Eastern Bay/Kent Narrows/Lower Chester River/Langford Creek/Kent Island Bay	23.24	20.66	14.16	9.61	56.93
Middle Chester River	12.51	12.61	5.06	5.64	23.07
Gunpowder River/Lower Gunpowder Falls/Bird River/Middle River-Browns	30.44	25.54	16.81	8.24	60.46
Back River	14.73	14.90	5.26	7.40	21.07
Loch Raven Reservoir	37.21	36.74	19.59	9.22	83.37
Jones Falls	43.90	46.34	19.71	16.89	78.39
South River/West River	44.81	48.46	23.22	2.45	80.10
Middle Patuxent River	28.57	32.79	10.56	10.48	38.78
Rocky Gorge Dam	32.98	34.41	10.38	15.37	52.74
Potomac River Lower Tidal/Potomac River Middle Tidal	80.86	83.33	14.91	49.15	98.49
Breton/St. Clements Bays	68.75	69.93	17.80	39.26	94.40
Potomac River Montgomery County	45.04	37.64	21.08	17.35	82.65
Conewago Creek/Double Pipe Creek	23.16	19.62	15.32	4.51	57.88
Potomac River Washington County/Marsh Run/Tonoloway/ Little Tonoloway	69.14	83.91	27.96	13.05	95.27
Conococheague	12.06	12.04	10.15	1.38	33.65
Savage River	76.41	83.41	18.04	43.27	98.46
Town Creek	83.72	83.71	9.58	61.28	100.00

APPENDIX C
SUMMARY OF TEMPERATURE LOGGER DATA

Table C-1. Summary indicator statistics calculated from water temperature loggers. Notes indicate special circumstances encountered in deploying or retrieving temp logger. Temperatures are in C. Temperature loggers were deployed from about June to September in 2002.

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
BACK-101-R-2002	27.12	22.33	20.99	23.76	25.37	83.73	24.30	0.00	
BACK-105-R-2002									Data logger failure
BACK-108-R-2002	29.08	22.23	21.29	23.25	24.99	83.91	24.81	0.00	
BACK-110-R-2002	32.64	23.63	21.18	26.78	29.03	87.37	45.03	0.12	
BACK-111-R-2002	27.64	22.44	21.00	24.11	25.53	84.04	27.24	0.00	
BACK-112-R-2002	27.75	22.92	21.72	24.31	25.97	89.59	35.99	0.00	
BACK-113-R-2002									Data logger lost
BACK-203-R-2002	26.30	22.40	21.56	23.31	25.26	85.36	27.71	0.00	
BACK-302-R-2002	30.30	22.82	21.85	24.11	25.97	90.50	31.49	0.00	
BACK306-R-2002	38.31	25.53	21.77	32.67	38.31	90.92	58.73	10.34	
BIRD-101-R-2002	28.81	22.94	21.26	24.85	26.47	88.35	36.54	0.00	
BIRD-107-R-2002	25.72	20.87	19.56	22.09	24.16	62.87	6.88	0.00	
BRET-101-R-2002	24.36	21.08	20.36	21.75	23.67	69.31	2.13	0.00	
BRET-103-R-2002	37.96	25.87	19.65	30.76	37.96	75.63	53.31	23.10	Site dry in summer
BRET-115-R-2002	38.10	25.26	19.77	29.74	38.10	68.40	49.62	20.37	
BRET-117-R-2002	38.13	25.68	19.50	30.80	38.13	76.41	52.48	21.43	Site dry in summer
BRET-408-R-2002	38.16	22.12	19.80	25.35	26.67	77.08	24.43	0.54	
CONO-101-R-2002	30.73	20.97	16.55	25.98	27.61	56.26	25.62	0.00	
CONO-105-R-2002	31.79	22.33	18.91	26.64	27.87	74.30	32.52	0.00	
CONO-107-R-2002	27.30	17.77	15.24	20.89	23.65	22.15	4.32	0.00	
CONO-110-R-2002	27.30	17.77	15.24	20.89	23.65	22.15	4.32	0.00	
CONO-114-R-2002	22.00	15.97	14.22	18.27	19.22	1.10	0.00	0.00	
CONO-116-R-2002	36.22	22.29	19.63	26.48	27.18	77.38	28.31	0.38	
CONO-217-R-2002	23.85	18.49	16.72	20.23	21.51	25.17	0.00	0.00	
CONO-218-R-2002	27.00	22.76	21.41	24.10	25.60	91.74	29.40	0.00	
CONO-222-R-2002	28.05	20.56	18.00	23.11	25.75	56.45	14.59	0.00	
CONO-312-R-2002	24.62	20.16	18.70	21.47	23.59	54.28	3.20	0.00	
CORS-102-2002	38.08	23.79	19.74	27.16	38.08	67.59	31.61	14.26	Site dry in summer
DOUB-101-R-2002	22.27	17.86	16.86	18.94	20.61	9.70	0.00	0.00	
DOUB-103-R-2002	19.71	17.06	16.46	17.70	19.06	0.00	0.00	0.00	
DOUB-106-R-2002	37.96	25.64	19.44	31.45	37.96	77.92	51.16	21.43	Site dry in summer
DOUB-109-R-2002	38.03	25.38	19.78	30.59	38.03	79.06	48.29	19.13	Site dry in summer
DOUB-113-R-2002	22.65	19.31	18.05	20.55	21.66	39.32	0.00	0.00	
DOUB-115-R-2002	29.37	22.29	20.09	24.73	26.47	78.36	29.68	0.00	
DOUB-116-R-2002	21.51	17.80	16.70	19.27	20.04	5.82	0.00	0.00	
DOUB-119-R-2002	22.37	19.07	18.40	19.75	21.71	35.13	0.00	0.00	
DOUB-120-R-2002	23.22	18.49	17.08	20.19	21.55	21.37	0.00	0.00	
DOUB-122-R-2002	25.57	21.12	19.62	22.27	24.53	69.75	9.70	0.00	
DOUB-212-R-2002	30.36	21.54	18.81	25.53	26.73	68.84	20.94	0.00	
DOUB-214-R-2002	27.25	20.93	18.58	23.26	25.15	64.05	13.83	0.00	

Table C-1. (Continued)

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
DOUB-217-R-2002	33.56	23.28	19.81	27.48	29.72	79.59	40.30	1.03	
DOUB-218-R-2002	26.01	20.47	19.01	21.96	23.59	61.48	3.49	0.00	
DOUB-221-R-2002	30.68	21.11	19.03	23.26	25.09	67.77	11.39	0.00	
DOUB-404-R-2002	29.64	23.73	22.41	25.20	27.28	91.58	51.30	0.00	
DOUB-407-R-2002	29.54	23.87	22.44	25.34	27.72	95.07	50.30	0.00	
FIMI-207-R-2002	33.23	20.70	17.08	25.50	26.51	60.96	16.20	0.02	
FURN-101-R-2002	35.80	20.22	18.73	21.99	25.44	52.69	7.74	0.05	
GUNP-104-R-2002	29.09	19.87	18.50	21.29	24.66	46.00	7.30	0.00	Site dry in summer
JONE-101-R-2002									Data logger failure
JONE-102-R-2002	38.18	27.73	20.35	33.27	38.18	84.72	66.06	30.07	
JONE-105-R-2002	38.08	27.86	20.47	33.28	38.08	86.63	66.71	30.34	
JONE-107-R-2002	29.07	20.64	17.83	23.68	26.37	57.06	16.85	0.00	
JONE-109-R-2002	30.21	20.85	18.19	23.92	26.58	58.69	16.62	0.00	
JONE-109-S-2002	20.76	15.31	14.48	16.41	17.03	0.08	0.00	0.00	
JONE-110-R-2002									Data logger failure
JONE-204-R-2002	33.96	20.79	18.03	23.74	27.88	57.36	16.29	0.05	
JONE-213-R-2002	20.72	16.17	15.16	17.34	18.12	0.45	0.00	0.00	
JONE-303-R-2002	26.52	21.47	20.03	23.04	25.12	72.26	14.88	0.00	
JONE-321-R-2002	35.30	24.10	22.94	25.94	27.09	99.03	56.78	0.18	
JONE-315-S-2002	30.06	20.26	18.67	22.66	24.35	55.45	6.94	0.00	
LANG-101-R-2002	24.03	20.68	19.52	21.95	23.34	65.90	0.36	0.00	
LANG-108-R-2002	34.71	22.30	20.05	25.24	27.31	75.32	30.75	0.11	Site dry in summer
LANG-109-R-2002	26.45	20.94	19.02	23.43	24.54	66.32	9.25	0.00	
LANG-115-R-2002	25.95	18.98	17.94	20.00	21.86	29.37	1.54	0.00	
LANG-204-R-2002	27.26	22.67	22.16	23.34	24.63	97.66	21.03	0.00	
LANG-218-R-2002	29.06	22.50	20.37	25.25	26.89	80.60	30.10	0.00	
LIBE-101-X-2002	26.11	19.91	18.43	21.72	23.18	51.09	1.51	0.00	
LIBE-102-S-2002	26.77	19.33	17.70	21.01	23.66	41.37	3.90	0.00	
LIBE-102-X-2002	25.90	18.91	17.93	20.08	21.48	30.98	0.20	0.00	
LIBE-103-X-2002	28.13	18.31	17.14	19.85	20.91	13.76	0.48	0.00	
LOCH-101-R-2002	25.42	19.58	17.52	22.02	23.18	47.70	2.27	0.00	
LOCH-102-R-2002									Data logger lost
LOCH-107-R-2002									Data logger lost
LOCH-109-R-2002	25.42	19.58	17.52	22.02	23.18	47.70	2.27	0.00	
LOCH-111-R-2002	24.74	18.90	16.87	20.90	23.19	35.63	1.36	0.00	
LOCH-112-R-2002	23.14	18.44	17.17	19.66	21.29	20.05	0.00	0.00	
LOCH-114-R-2002	22.09	17.74	16.80	18.72	20.43	10.38	0.00	0.00	
LOCH-115-R-2002	26.04	21.00	19.86	22.27	24.31	64.46	8.51	0.00	
LOCH-120-R-2002	37.44	20.46	18.62	24.66	24.69	57.48	9.25	0.20	
LOCH-121-R-2002	24.49	19.35	17.69	21.08	22.78	42.55	0.45	0.00	
LOCH-122-R-2002									Data logger lost
LOCH-123-R-2002	25.07	19.85	18.51	21.44	23.01	50.51	1.50	0.00	

Table C-1. (Continued)

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
LOCH-213-R-2002	23.89	19.45	17.87	21.06	22.54	40.86	0.00	0.00	
LOCH-216-R-2002	24.50	18.90	16.98	20.83	22.79	33.36	0.82	0.00	
LOCH-224-R-2002	27.78	21.37	19.02	23.91	25.84	67.33	20.17	0.00	
LOCH-305-R-2002	29.11	21.18	19.21	23.62	25.19	66.30	13.86	0.00	
LOCH-404-R-2002	27.63	22.30	20.76	23.89	26.04	79.18	30.21	0.00	
LOCH-443-R-2002	21.62	13.64	12.09	16.01	17.57	0.48	0.00	0.00	
LOCR-102-R-2002	27.01	21.97	21.11	22.86	25.09	80.08	18.99	0.00	
LOCR-102-S-2002	38.29	22.88	20.51	26.77	28.37	81.73	33.12	1.01	
LOCR-110-R-2002									Data logger failure
LOCR-114-R-2002	28.47	22.94	21.72	24.16	26.15	89.56	31.87	0.00	
LOCR-116-R-2002	26.48	20.83	20.06	21.63	24.74	60.35	11.92	0.00	
LOGU-103-2002	26.27	21.79	20.77	23.18	24.53	81.82	11.95	0.00	
LOGU-106-R-2002	26.47	20.73	19.15	22.63	24.22	62.48	7.21	0.00	
LOGU-108-R-2002	26.13	21.00	20.18	22.11	23.88	70.13	4.22	0.00	
LOGU-109-R-2002	25.31	20.59	19.51	21.57	23.75	58.67	4.34	0.00	
LOGU-202-R-2002	30.17	18.48	16.96	20.39	21.08	15.58	0.62	0.00	
LOGU-211-R-2002	18.99	13.60	13.01	14.66	14.86	0.00	0.00	0.00	
LOGU-305-R-2002	25.51	19.35	16.68	22.40	23.61	38.14	3.29	0.00	
LOPC-101-R-2002	34.09	21.72	20.40	23.07	24.16	82.32	7.13	0.47	
LOPC-108-R-2002	38.18	23.37	19.37	28.66	30.13	85.38	40.34	3.41	
LOPC-109-R-2002	33.59	24.42	22.55	26.70	28.84	94.93	59.20	0.45	
LOPC-110-R-2002	34.00	15.82	15.06	16.79	19.94	4.77	1.59	0.18	
LOPC-112-R-2002	34.60	23.18	19.89	27.38	30.88	74.08	40.42	2.63	Site dry in summer
LOPC-115-R-2002	34.08	22.62	20.28	26.11	27.84	82.68	28.52	0.27	
LOPC-116-R-2002	34.39	21.37	20.76	22.23	24.06	69.50	7.92	0.40	
LOPC-118-R-2002	34.08	22.62	20.28	26.11	27.84	82.68	28.52	0.27	
LOPC-206-R-2002	32.19	21.28	19.50	22.96	25.10	65.32	15.26	0.05	
LOPC-211-R-2002	32.19	21.28	19.50	22.96	25.10	65.32	15.26	0.05	
LTON-113-R-2002	33.83	18.50	17.70	19.63	22.42	26.42	2.11	0.13	
LTON-205-R-2002	26.01	21.37	19.88	22.93	24.62	72.20	11.64	0.00	
LTON-210-R-2002	26.01	21.37	19.88	22.93	24.62	72.20	11.64	0.00	
MARS-211-R-2002	30.84	23.04	20.49	25.49	28.07	82.59	39.03	0.00	
MATT-033-R-2002	37.98	22.28	18.91	28.42	29.62	72.80	26.53	2.46	
MICR-106-R-2002	21.70	18.42	18.25	18.63	21.19	25.19	0.00	0.00	
MICR-110-R-2002	25.53	21.76	21.04	22.49	24.66	79.98	14.40	0.00	
MICR-113-R-2002	25.33	20.78	19.47	21.99	24.12	62.57	7.42	0.00	
MICR-118-R-2002	23.04	18.76	17.66	20.01	21.04	24.09	0.00	0.00	
MICR-202-R-2002	24.49	18.74	17.75	19.85	21.46	13.09	0.54	0.00	
MICR-205-R-2002	30.02	22.72	20.14	25.98	27.46	81.02	33.29	0.00	
MICR-207-R-2002	31.44	23.26	20.19	26.81	28.46	83.79	39.51	0.00	
MICR-208-R-2002	25.21	19.94	18.01	22.17	23.31	46.75	1.99	0.00	

Table C-1. (Continued)

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
MICR-215-R-2002	26.82	23.24	22.52	24.05	25.77	95.95	38.67	0.00	
MICR-216-R-2002	24.92	20.05	18.84	21.46	22.69	53.08	0.76	0.00	
MPAX-101-R-2002	29.89	19.88	18.18	22.37	24.03	48.37	5.39	0.00	
MPAX-103-R-2002	24.82	20.20	18.98	21.42	23.62	53.52	2.83	0.00	
MPAX-104-R-2002	29.49	20.15	18.31	23.22	24.53	54.52	7.83	0.00	
MPAX-107-R-2002	22.68	19.34	18.60	20.03	21.68	38.00	0.00	0.00	
MPAX-205-R-2002	27.68	22.57	21.29	23.76	25.74	90.56	25.07	0.00	
MPAX-206-R-2002	24.90	19.58	18.00	21.57	22.84	45.81	1.74	0.00	
MPAX-310-R-2002	27.78	22.18	20.51	23.79	26.19	78.24	25.55	0.00	
MPAX-313-R-2002	27.51	21.30	19.66	23.25	24.89	69.75	12.07	0.00	
MPAX-409-2002	27.90	22.64	21.41	23.94	26.13	85.04	33.32	0.00	
MPAX-411-R-2002	27.78	22.50	21.04	23.88	26.18	82.35	33.09	0.00	
NANJ-331-S-2002	33.01	22.37	18.93	26.78	29.39	73.03	30.13	0.50	
NANT-104-R-2002	38.04	22.82	17.83	31.79	30.76	75.46	37.48	3.76	Site dry in summer
NANT-106-R-2002	32.92	21.21	19.22	23.13	26.27	63.13	19.98	0.02	
NANT-108-R-2002	31.99	20.02	19.38	20.75	23.53	56.36	1.68	0.00	
NANT-109-R-2002	32.46	21.31	19.79	22.85	25.15	67.48	18.38	0.08	
NANT-110-R-2002	32.92	21.21	19.22	23.13	26.27	63.13	19.98	0.02	
NANT-111-R-2002	32.76	20.52	19.84	21.26	24.38	63.08	10.10	0.03	
NANT-113-R-2002	32.92	21.21	19.22	23.13	26.27	63.13	19.98	0.02	
NANT-116-R-2002	38.19	22.93	19.26	29.08	30.32	74.45	36.80	1.84	
NANT-122-R-2002	33.93	25.10	23.91	26.56	27.87	98.85	73.56	0.32	
NANT-123-R-2002	33.11	18.47	17.76	19.28	22.31	23.16	0.98	0.21	
NASS-108-S-2002	35.04	21.26	19.41	23.00	25.14	64.97	18.16	0.48	
NASS-302-S-2002	35.07	21.57	20.33	22.92	24.84	70.59	14.63	0.51	
PAXL-294-S-2002	31.77	21.81	19.66	24.48	26.47	74.71	16.98	0.00	
PRLN-626-S-2002	22.66	18.80	17.73	19.79	21.83	35.00	0.00	0.00	
PRLT-104-R-2002	25.91	21.68	20.51	22.75	25.04	76.56	17.91	0.00	
PRLT-105-R-2002	34.28	21.32	19.51	23.83	26.91	61.82	18.99	0.11	
PRLT-108-R-2002	28.27	22.07	19.93	24.15	25.96	79.89	22.91	0.00	Site dry in summer
PRLT-113-R-2002	23.84	20.37	19.46	21.32	22.99	58.84	0.00	0.00	
PRLT-116-R-2002									Site dry in summer
PRMO-101-R-2002	29.82	21.78	19.00	24.65	26.75	70.30	24.94	0.00	Site dry in summer
PRMO-103-R-2002	29.46	20.54	19.63	21.69	23.64	56.50	3.43	0.00	
PRMO-109-R-2002									?
PRMO-110-R-2002	29.67	21.52	20.12	23.06	24.51	73.67	11.11	0.00	
PRMO-112-R-2002	30.19	22.04	20.67	23.61	25.52	77.49	24.07	0.00	
PRMO-114-R-2002	22.70	19.27	18.19	20.44	21.70	39.38	0.00	0.00	
PRMO-115-R-2002	22.70	19.27	18.19	20.44	21.70	39.38	0.00	0.00	
PRMO-120-R-2002	32.56	20.19	18.04	22.64	24.89	53.06	9.60	0.02	
PRMO-202-R-2002	36.11	22.40	20.49	24.56	27.39	75.39	31.81	0.06	
PRMO-222-R-2002	28.98	21.13	20.16	22.15	23.86	72.81	4.95	0.00	

Table C-1. Continued

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
PRMO-304-R-2002	28.07	22.14	20.73	23.59	25.94	78.77	23.64	0.00	
PRMO-307-R-2002									?
PRMO-311-R-2002	28.52	22.40	20.62	24.31	26.03	79.84	30.39	0.00	
PRMO-313-R-2002	26.17	21.17	19.89	22.28	24.61	69.36	10.52	0.00	
PRMO-323-R-2002	28.07	22.14	20.73	23.59	25.94	78.77	23.64	0.00	
PRMT-110-R-2002									Site dry in summer
PRMT-118-R-2002	32.23	24.93	22.31	27.65	29.76	93.06	63.12	0.15	
PRMT-201-R-2002	38.17	25.42	20.24	29.46	38.17	72.06	48.47	20.75	
PRMT-206-R-2002	32.73	23.49	21.07	26.36	29.13	91.36	41.95	0.12	
PRMT-315-R-2002	33.11	22.27	20.87	24.04	25.72	82.20	21.31	0.06	
PRWA-101-R-2002	35.00	21.77	[illegible]	23.83	26.14	74.97	18.65	0.98	Site dry in summer
PRWA-102-R-2002	31.12	19.29	17.10	22.11	25.86	37.10	11.13	0.00	
PRWA-114-R-2002	38.03	22.46	20.37	24.89	29.09	80.87	23.98	2.64	Site dry in summer
PRWA-120-R-2002	28.98	21.79	19.67	24.34	25.93	73.44	20.99	0.00	
PRWA-124-R-2002									Site dry in summer
PRWA-125-R-2002	34.71	21.18	19.13	23.65	25.88	67.33	16.13	0.72	Site dry in summer
PRWA-206-R-2002	20.98	14.29	12.99	16.35	16.80	0.09	0.00	0.00	
PRWA-215-R-2002	17.36	13.99	13.00	15.57	15.93	0.00	0.00	0.00	
PRWA-217-R-2002	34.28	22.08	19.89	24.67	27.47	80.45	17.68	0.74	Site dry in summer
PTOB-002-S-2002	31.74	21.99	18.77	25.79	28.39	71.02	26.88	0.00	
RKGR-101-R-2002	24.10	20.01	18.98	21.04	22.74	53.49	0.21	0.00	
RKGR-106-R-2002	25.45	20.77	19.74	21.94	23.39	65.67	1.86	0.00	
RKGR-107-R-2002	25.28	20.39	19.02	22.03	23.72	57.30	3.67	0.00	
RKGR-110-R-2002	27.39	20.49	18.90	22.37	24.43	56.94	8.08	0.00	
RKGR-112-R-2002	25.28	20.39	19.02	22.03	23.72	57.30	3.67	0.00	
RKGR-119-S-2002	23.84	19.93	18.82	21.00	22.99	52.70	0.00	0.00	
RKGR-208-R-2002	25.08	20.45	19.18	21.68	23.69	58.87	3.37	0.00	
RKGR-403-R-2002	25.48	21.56	20.70	22.39	24.27	90.37	9.16	0.00	
RKGR-404-R-2002	24.92	21.36	20.18	22.80	23.70	86.94	2.92	0.00	
RKGR-405-R-2002	25.92	22.05	20.97	23.13	24.54	89.26	10.83	0.00	
RKGR-409-R-2002	24.00	21.69	20.79	22.57	23.48	89.33	0.56	0.00	
SAVA-103-R-2002	36.86	16.36	14.66	18.18	19.55	3.73	0.11	0.07	
SAVA-104-R-2002	34.63	18.09	14.99	25.22	23.61	24.14	4.50	0.11	
SAVA-105-R-2002	19.59	15.43	14.26	16.53	18.46	0.00	0.00	0.00	
SAVA-115-R-2002	20.36	16.29	14.60	17.99	19.22	0.97	0.00	0.00	Site dry in summer
SAVA-116-R-2002	35.07	17.41	14.28	23.25	22.57	19.60	1.78	0.02	
SAVA-117-R-2002	29.27	17.07	15.74	18.75	21.28	7.87	1.63	0.00	
SAVA-119-R-2002	34.63	18.09	14.99	25.22	23.61	24.14	4.50	0.11	
SAVA-120-R-2002	24.20	17.90	14.96	20.90	22.33	26.24	0.14	0.00	
SAVA-204-S-2002	29.00	17.94	14.69	22.49	22.87	26.71	0.14	0.00	
SAVA-206-R-2002	21.52	17.26	15.90	18.41	20.37	7.59	0.00	0.00	
SAVA-225-S-2002	24.44	18.14	15.91	20.33	22.07	22.53	0.51	0.00	Temp logger out of water in summer

Table C-1. (Continued)

Site	Absolute Maximum	Mean Average Daily Temperature	Mean Minimum Daily Temperature	Mean Maximum Daily Temperature	95th Percentile	Percent Exceedences 20 C	Percent Exceedences 23.9 C	Percent Exceedences 30 C	Comments
SAVA-276-S-2002	17.19	13.74	13.01	14.47	15.93	0.00	0.00	0.00	
SAVA-308-R-2002	26.52	19.09	16.71	21.89	23.24	42.47	2.61	0.00	
SAVA-312-R-2002	26.72	18.19	15.39	20.98	22.58	27.07	0.94	0.00	
SAVA-401-R-2002	18.41	13.70	12.32	15.60	16.64	0.00	0.00	0.00	
SAVA-410-R-2002	18.41	13.70	12.32	15.60	16.64	0.00	0.00	0.00	
SAVA-414-R-2002	18.41	13.70	12.32	15.60	16.64	0.00	0.00	0.00	
SOUT-101-R-2002	25.18	20.19	18.68	21.95	23.63	54.03	3.54	0.00	
SOUT-103-R-2002	22.99	19.97	19.24	20.71	22.16	53.40	0.00	0.00	
SOUT-105-R-2002	16.97	15.49	15.37	15.63	16.66	0.00	0.00	0.00	
SOUT-106-R-2002									Site dry in summer
SOUT-108-R-2002	25.78	23.02	22.57	23.60	25.26	98.32	33.98	0.00	
SOUT-109-R-2002	26.06	19.42	18.70	20.33	21.60	37.90	0.36	0.00	
STCL-051-S-2002	25.81	20.61	19.49	21.71	23.90	60.24	4.64	0.00	
STCL-106-R-2002	38.23	25.86	19.84	31.04	38.23	74.92	53.75	21.96	
STCL-110-R-2002	28.78	21.10	19.25	22.98	25.41	69.33	10.94	0.00	
STCL-112-R-2002	25.24	21.07	20.00	22.15	24.21	67.27	8.14	0.00	
STCL-116-R-2002	27.86	20.38	19.82	21.15	24.00	55.39	5.24	0.00	
STCL-213-R-2002	38.02	23.04	19.26	29.34	29.99	79.04	37.73	1.60	
TOWN-104-R-2002	28.66	19.24	17.87	20.61	21.89	39.47	1.56	0.00	
TOWN-108-R-2002	24.34	19.73	18.21	21.17	22.97	49.51	0.72	0.00	
TOWN-110-R-2002									Site dry in summer
TOWN-111-R-2002	38.13	23.07	20.62	25.98	32.37	84.66	32.95	5.25	Site dry in summer
TOWN-116-R-2002	38.15	21.16	19.25	23.49	25.66	65.27	16.74	1.49	Site dry in summer
TOWN-201-R-2002	34.52	22.38	18.79	27.13	28.58	74.55	33.44	0.64	
TOWN-205-R-2002	20.89	15.79	13.82	18.57	19.28	1.49	0.00	0.00	
TOWN-417-R-2002	30.09	23.11	20.27	26.24	27.54	86.17	40.37	0.00	
TOWN-419-R-2002	33.91	24.56	21.70	28.24	30.23	91.82	57.13	1.12	
TOWN-420-R-2002	33.91	24.56	21.70	28.24	30.23	91.82	57.13	1.12	
UMON-119-S-2002	32.04	18.40	17.31	19.52	21.06	23.10	0.77	0.03	
UMON-288-S-2002									?
UPCK-113-S-2002	24.59	21.25	20.53	22.08	23.90	72.61	3.94	0.00	
WCHE-086-S-2002	38.28	25.23	19.63	30.36	38.28	77.89	50.30	17.32	Site dry in summer
WEST-104-R-2002	38.23	22.52	19.56	28.99	28.89	72.14	32.74	1.18	
WEST-110-R-2002	32.07	22.65	20.47	25.34	26.41	83.54	37.19	0.02	
WEST-111-R-2002	24.96	20.20	18.86	21.64	23.92	53.23	5.85	0.00	Site dry in summer
WEST-114-R-2002									Site dry in summer
WIHR-220-S-2002	34.13	19.50	18.17	21.08	21.71	32.93	1.07	0.24	
YOUG-432-S-2002	22.39	17.46	16.21	18.73	20.74	9.91	0.00	0.00	
ZEKI-012-S-2002	28.65	21.32	19.20	23.64	25.10	72.83	11.70	0.00	

APPENDIX D
SENTINEL SITE DATA

Table D-1. Sites sampled by MBSS prior to the 2000 sampling season that met abiotic season criteria for Sentinel sites

SITE (95-97)	SITENEW	SAM-PLED	STREAM NAME	ORDER	STRATA_R	PH_ LAB	NO3_ LAB	SO4_ LAB	DOC_ LAB	ACIDSRC	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
KE-N-096-102-95	LOCR-102-S-1995	1995	SWAN CREEK	1	COASTAL-E	5.86	0.120	17.460	20.000	ORG & AD	70.33	2.75	1.86	1.86	0	1
	LOCR-102-S-2000	2000	SWAN CREEK	1	COASTAL-E	6.02	0.085	4.943	33.182	ORG	85.19	2.75	1.29	1.29	0	1
	LOCR-102-S-2001	2001	SWAN CREEK	1	COASTAL-E	5.92	0.169	7.821	20.150	ORG	85.19	2.75	1.86	1.86	0	1
	LOCR-102-S-2002	2002	SWAN CREEK	1	COASTAL-E	5.82	0.072	24.622	15.856	ORG & AD	85.19	2.50	1.86	1.86	0	1
WO-S-038-108-97	NASS-108-S-1997	1997	MILLVILLE CREEK	1	COASTAL-E	4.40	0.350	3.990	32.900	ORG	83.23	3.25	1.29	2.27	0	1
	NASS-108-S-2000	2000	MILLVILLE CREEK	1	COASTAL-E	4.41	0.082	3.405	36.061	ORG	77.82	2.00	1.00	1.00	0	1
	NASS-108-S-2001	2001	MILLVILLE CREEK	1	COASTAL-E	4.36	0.182	5.479	27.625	ORG	77.82	2.25	1.29	1.29	0	1
	NASS-108-S-2002	2002	MILLVILLE CREEK	1	COASTAL-E	4.40	0.032	11.121	18.625	ORG & AD	77.82	2.00	1.00	1.00	0	1
CN-N-024-113-96	UPCK-113-S-1996	1996	SKELETON CREEK	1	COASTAL-E	5.95	0.600	15.900	15.900	ORG & AD	61.01	2.75	2.14	2.14	0	1
	UPCK-113-S-2000	2000	SKELETON CREEK	1	COASTAL-E	5.53	0.117	6.413	28.632	ORG	61.01	2.50	2.71	2.71	0	1
	UPCK-113-S-2001	2001	SKELETON CREEK	1	COASTAL-E	6.12	0.303	10.977	17.414	ORG & AD	61.00	2.50	2.71	2.71	0	1
	UPCK-113-S-2002	2002	SKELETON CREEK	1	COASTAL-E	6.84	0.361	24.108	3.536	NONE	61.00	2.75	2.43	2.59	0	0
WI-S-063-220-95	WIRH-220-S-1995	1995	LEONARD POND RUN	2	COASTAL-E	6.64	2.080	5.280	6.000	NONE	56.48	3.25	3.00	3.13	0	0
	WIRH-220-S-2000	2000	LEONARD POND RUN	2	COASTAL-E	6.23	0.548	1.734	16.032	ORG	51.41	3.25	3.57	3.41	0	1
	WIRH-220-S-2001	2001	LEONARD POND RUN	2	COASTAL-E	6.76	3.860	5.137	3.652	NONE	51.41	3.25	4.43	3.84	0	0
	WIRH-220-S-2002	2002	LEONARD POND RUN	2	COASTAL-E	6.87	6.185	6.621	1.958	NONE	51.41	3.50	3.86	3.68	0	0
QA-N-086-118-95	WYER-118-S-1995	1995	UT WYE EAST RIVER	1	COASTAL-E	6.80	1.160	13.260	22.000	NONE	57.09	3.00	3.86	3.43	0	0
	WYER-118-S-2000	2000	UT WYE EAST RIVER	1	COASTAL-E	6.89	1.330	9.818	26.695	NONE	55.39	2.75	3.00	2.88	0	0
	CORS-102-R-2000	2000	KIRBY CREEK	1	COASTAL-E	6.35	0.164	5.435	17.384	ORG	89.92	1.75	3.29	3.29	0	1
	CORS-102-S-2001	2001	KIRBY CREEK	1	COASTAL-E	6.56	0.440	8.241	8.682	ORG & AD	89.92	1.75	2.71	2.71	0	1
	CORS-102-S-2002	2002	KIRBY CREEK	1	COASTAL-E	6.80	0.233	27.510	6.518	NONE	89.92	DRY	1.57	1.57	0	0
	NASS-302-S-2001	2001	NASSAWANGO CREEK	3	COASTAL-E	6.25	0.252	7.297	12.198	ORG & AD	71.66	3.25	3.29	3.27	0	1
	NASS-302-S-2002	2002	NASSAWANGO CREEK	3	COASTAL-E	6.52	0.001	8.622	10.680	NONE	71.66	4.25	3.57	3.91	0	0
CH-S-033-314-95	MATT-033-S-1995	1995	MATTAWOMAN CREEK	3	COASTAL-W	6.60	0.240	12.840	4.000	AD	69.63	3.50	2.71	3.11	0	0
	MATT-033-S-2000	2000	MATTAWOMAN CREEK	3	COASTAL-W	6.73	0.137	9.472	6.957	AD	70.03	3.50	3.86	3.68	0	0
	MATT-033-S-2001	2001	MATTAWOMAN CREEK	3	COASTAL-W	6.72	0.115	11.134	3.497	AD	69.69	3.00	3.29	3.14	0	0
	MATT-033-S-2002	2002	MATTAWOMAN CREEK	3	COASTAL-W	6.58	0.122	14.337	6.011	AD	69.69	2.50	3.00	2.75	0	0
CH-S-331-304-95	NANJ-331-S-1995	1995	MILL RUN	3	COASTAL-W	6.46	0.330	11.610	3.000	AD	81.14	4.75	3.86	4.31	0	0
	NANJ-331-S-2000	2000	MILL RUN	3	COASTAL-W	6.47	0.164	10.634	3.087	AD	81.25	3.00	3.57	3.29	0	0
	NANJ-331-S-2001	2001	MILL RUN	3	COASTAL-W	6.66	0.236	10.836	1.649	AD	81.36	2.50	4.71	3.61	0	0
	NANJ-331-S-2002	2002	MILL RUN	3	COASTAL-W	6.60	0.090	9.923	3.144	AD	81.36	4.25	4.71	4.48	0	0
CH-S-294-236-97	PAXL-294-S-1997	1997	SWANSON CREEK	2	COASTAL-W	6.85	0.600	14.760	2.500	AD	69.33	4.25	3.57	3.91	0	0
	PAXL-294-S-2000	2000	SWANSON CREEK	2	COASTAL-W	6.70	0.313	14.736	3.106	AD	69.71	3.00	3.86	3.43	0	0
	PAXL-294-S-2001	2001	SWANSON CREEK	2	COASTAL-W	6.94	0.424	14.800	1.864	AD	69.82	3.00	4.14	3.57	0	0
	PAXL-294-S-2002	2002	SWANSON CREEK	2	COASTAL-W	6.83	0.213	15.373	3.770	NONE	69.82	4.50	4.14	4.32	0	0
CH-S-002-207-95	PTOB-002-S-1995	1995	HOGHOLE RUN	2	COASTAL-W	6.62	0.200	10.510	3.000	AD	83.58	4.50	3.29	3.90	0	0
	PTOB-002-S-2000	2000	HOGHOLE RUN	2	COASTAL-W	6.46	0.000	9.926	3.446	AD	83.55	4.25	3.57	3.91	0	0
	PTOB-002-S-2001	2001	HOGHOLE RUN	2	COASTAL-W	6.59	0.001	9.788	1.523	AD	82.68	4.25	3.86	4.05	0	0
	PTOB-002-S-2002	2002	HOGHOLE RUN	2	COASTAL-W	6.62	0.036	7.705	3.662	AD	82.68	4.25	4.71	4.48	0	0
SM-S-051-132-95	STCL-051-S-1995	1995	UT ST CLEMENTS CREEK	1	COASTAL-W	6.86	0.200	7.050	4.000	NONE	79.26		3.86	3.86	0	0
	STCL-051-S-2000	2000	UT ST CLEMENTS CREEK	1	COASTAL-W	7.03	0.000	6.053	3.436	NONE	74.93		3.57	3.57	0	0
	STCL-051-S-2001	2001	UT ST CLEMENTS CREEK	1	COASTAL-W	6.96	0.001	6.558	2.560	NONE	74.93		4.71	4.71	0	0
	STCL-051-S-2002	2002	UT ST CLEMENTS CREEK	1	COASTAL-W	7.06	0.001	5.584	3.437	NONE	74.93		4.71	4.71	0	0
CA-S-086-209-97	WCHE-086-S-1997	1997	PLUM POINT CREEK	2	COASTAL-W	7.36	0.000	16.210	3.200	NONE	74.93	2.75	3.29	3.02	0	0
	WCHE-086-S-2000	2000	PLUM POINT CREEK	2	COASTAL-W	7.07	0.061	14.256	5.199	NONE	74.61	2.00	2.14	2.07	0	0
	WCHE-086-S-2001	2001	PLUM POINT CREEK	2	COASTAL-W	7.35	0.229	16.837	2.851	NONE	73.87	1.75	3.00	2.38	0	0
	WCHE-086-S-2002	2002	PLUM POINT CREEK	2	COASTAL-W	7.14	0.116	16.182	5.006	NONE	73.87	DRY	3.57	3.57	0	0
CH-S-012-114-95	ZEKI-012-S-1995	1995	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.20	0.340	14.820	3.000	AD	95.19	3.75	4.43	4.09	0	0
	ZEKI-012-S-2000	2000	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.52	0.079	7.876	2.566	AD	92.95	3.25	4.14	3.70	0	0
	ZEKI-012-S-2001	2001	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.66	0.214	7.363	1.740	AD	93.04	3.50	4.14	3.82	0	0
	ZEKI-012-S-2002	2002	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.81	0.096	8.735	4.136	NONE	93.04	4.50	4.14	4.32	0	0

Table D-1. (Continued)

SITE (95-97)	SITENEW	SAM-PLED	STREAM NAME	ORDER	STRATA_R	PH_ LAB	NO3_ LAB	SO4_ LAB	DOC_ LAB	ACIDSRC	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
BA-P-234-109-95	JONE-109-S-1995	1995	DIPPING POND RUN	1	EPIEDMNT	6.77	2.510	2.090	1.000	NONE	74.33		3.67	3.67	1	0
	JONE-109-S-2000	2000	DIPPING POND RUN	1	EPIEDMNT	6.41	2.386	2.660	0.792	NONE	76.78		4.11	4.11	0	0
	JONE-109-S-2001	2001	DIPPING POND RUN	1	EPIEDMNT	6.67	2.921	1.138	1.091	NONE	76.78		4.11	4.11	0	0
	JONE-109-S-2002	2002	DIPPING POND RUN	1	EPIEDMNT	6.41	3.169	1.246	0.946	NONE	43.26		3.89	3.89	0	0
BA-P-077-315-96	JONE-315-S-1996	1996	NORTH BR JONES FALLS	3	EPIEDMNT	7.60	1.320	7.360	2.600	NONE	56.62	3.00	3.67	3.34	0	0
	JONE-315-S-2000	2000	NORTH BR JONES FALLS	3	EPIEDMNT	7.52	1.066	6.174	2.007	NONE	56.29	3.22	4.33	3.78	0	0
	JONE-315-S-2001	2001	NORTH BR JONES FALLS	3	EPIEDMNT	8.20	1.522	4.298	1.134	NONE	55.31	3.44	3.00	3.22	0	0
	JONE-315-S-2002	2002	NORTH BR JONES FALLS	3	EPIEDMNT	8.05	0.960	5.600	1.775	NONE	55.31	3.44	3.44	3.44	0	0
BA-P-025-102-96	LOCH-102-S-1996	1996	BEAVERDAM RUN	1	EPIEDMNT	6.37	1.530	4.810	4.900	AD	56.69	3.44	3.22	3.33	1	0
	LOCH-102-S-2000	2000	BEAVERDAM RUN	1	EPIEDMNT	6.32	2.326	2.360	1.779	AD	56.60	3.00	4.33	4.33	1	0
BA-P-015-120-96	LOCH-120-S-1996	1996	BAISMANS RUN	1	EPIEDMNT	6.97	2.550	3.990	1.100	AD	58.59	1.89	4.33	4.33	1	0
	LOCH-120-S-2000	2000	BAISMANS RUN	1	EPIEDMNT	7.01	1.075	4.918	0.988	AD	62.99	2.78	3.22	3.22	1	0
	LOCH-120-S-2001	2001	BAISMANS RUN	1	EPIEDMNT	7.14	1.658	2.888	0.790	AD	59.81	2.56	4.33	4.33	1	0
	LOCH-120-S-2002	2002	BAISMANS RUN	1	EPIEDMNT	7.32	1.594	2.204	1.129	NONE	59.81	2.78	3.67	3.67	1	0
BA-P-057-209-96	LOCH-209-S-1996	1996	GREENE BRANCH	2	EPIEDMNT	7.43	2.300	9.720	1.400	NONE	56.58	2.78	3.44	3.11	0	0
	LOCH-209-S-2000	2000	GREENE BRANCH	2	EPIEDMNT	7.54	1.745	10.518	1.229	NONE	53.91	3.22	3.67	3.45	0	0
HO-P-228-119-97	RKGR-119-S-1997	1997	UN TRIB TO PATUXENT R	1	EPIEDMNT	7.69	1.360	7.170	1.500	NONE	65.92	3.44	4.11	3.78	0	0
	RKGR-119-S-2000	2000	UN TRIB TO PATUXENT R	1	EPIEDMNT	7.49	1.205	7.586	1.564	NONE	66.76	3.89	3.44	3.67	0	0
	RKGR-119-S-2001	2001	UN TRIB TO PATUXENT R	1	EPIEDMNT	6.81	1.648	5.922	1.077	NONE	65.20	3.44	4.11	3.78	0	0
	RKGR-119-S-2002	2002	UN TRIB TO PATUXENT R	1	EPIEDMNT	7.88	1.599	5.783	1.403	NONE	65.20	3.22	3.67	3.44	0	0
	FURN-101-C-2000	2000	WINCH RUN (BUCK SWAMP CREEK)	1	EPIEDMNT	6.66	0.509	4.055	2.224	AD	86.36	3.89	4.56	4.23	0	0
	FURN-101-S-2001	2001	WINCH RUN (BUCK SWAMP CREEK)	1	EPIEDMNT	6.78	0.622	4.882	3.074	AD	86.46	3.89	4.11	4.00	0	0
	FURN-101-S-2002	2002	WINCH RUN (BUCK SWAMP CREEK)	1	EPIEDMNT	6.91	0.656	4.620	2.494	AD	86.46	4.11	4.33	4.22	0	0
	LIBE-102-C-2000	2000	TIMBER RUN	1	EPIEDMNT	6.97	1.126	4.826	0.935	NONE	76.96	4.33	4.11	4.22	1	0
	LIBE-102-S-2001	2001	TIMBER RUN	1	EPIEDMNT	7.14	1.272	4.273	1.140	NONE	74.67	3.22	3.44	3.33	1	0
	LIBE-102-S-2002	2002	TIMBER RUN	1	EPIEDMNT	7.01	1.210	4.272	1.210	NONE	74.67	3.22	4.33	3.78	1	0
AL-A-207-307-95	FIMI-207-S-1995	1995	FIFTEENMILE CREEK	3	HIGHLAND	6.91	0.260	10.340	2.000	AD	89.73	2.71	4.11	3.41	0	0
	FIMI-207-S-2000	2000	FIFTEENMILE CREEK	3	HIGHLAND	7.09	0.196	9.015	2.211	AD	89.69	3.29	3.44	3.37	0	0
	FIMI-207-S-2001	2001	FIFTEENMILE CREEK	3	HIGHLAND	7.10	0.402	8.793	0.898	AD	89.51	3.57	3.44	3.51	0	0
	FIMI-207-S-2002	2002	FIFTEENMILE CREEK	3	HIGHLAND	7.28	0.256	11.778	1.494	NONE	89.51	3.86	3.22	3.54	0	0
AL-A-626-216-96	PRLN-626-S-1996	1996	MILL RUN	2	HIGHLAND	7.51	0.680	12.890	1.100	NONE	100.60	2.71	3.67	3.67	1	0
	PRLN-626-S-2000	2000	MILL RUN	2	HIGHLAND	7.56	0.443	13.174	0.987	NONE	100.00	3.57	4.56	4.07	1	0
	PRLN-626-S-2001	2001	MILL RUN	2	HIGHLAND	7.67	0.841	12.188	0.879	NONE	100.00	3.86	4.11	3.98	1	0
	PRLN-626-S-2002	2002	MILL RUN	2	HIGHLAND	7.16	1.888	13.214	1.618	NONE	100.00	2.43	4.56	4.56	1	0
GA-A-159-202-96	SAVA-159-S-1996	1996	MIDDLE FORK RUN	2	HIGHLAND	6.83	0.720	14.050	1.000	AD	90.35	4.14	3.44	3.79	1	0
	SAVA-159-S-2000	2000	MIDDLE FORK RUN	2	HIGHLAND	7.03	0.425	13.162	0.789	AD	90.21	4.43	4.33	4.38	1	0
	SAVA-159-S-2001	2001	MIDDLE FORK RUN	2	HIGHLAND	7.12	0.774	12.592	0.548	AD	90.15	4.14	4.33	4.24	1	0
	SAVA-204-C-2001	2001	CRABTREE CR	2	HIGHLAND	7.37	0.707	12.914	0.579	NONE	89.30	3.86	4.33	4.10	1	0
	SAVA-204-S-2002	2002	CRABTREE CR	2	HIGHLAND	6.93	0.791	14.104	0.886	AD	89.30	2.71	3.67	3.67	1	0
GA-A-999-302-96	SAVA-225-S-1996	1996	SAVAGE RIVER	3	HIGHLAND	7.07	0.800	12.030	1.500	AD	83.46	4.14	4.33	4.24	1	0
	SAVA-225-S-2000	2000	SAVAGE RIVER	3	HIGHLAND	7.26	0.452	11.607	2.449	AD	83.87	3.57	4.78	4.18	1	0
	SAVA-225-S-2001	2001	SAVAGE RIVER	3	HIGHLAND	7.22	0.917	10.399	1.173	AD	83.84	4.14	3.67	3.90	1	0
	SAVA-225-S-2002	2002	SAVAGE RIVER	3	HIGHLAND	7.21	0.871	12.284	2.572	AD	83.84	2.71	4.33	4.33	1	0
GA-A-276-106-96	SAVA-276-S-1996	1996	DOUBLE LICK RUN	1	HIGHLAND	6.77	0.490	12.890	0.800	AD	92.12	4.71	3.67	4.19	1	0
	SAVA-276-S-2000	2000	DOUBLE LICK RUN	1	HIGHLAND	6.75	0.329	12.110	0.700	AD	92.64	4.14	4.33	4.24	1	0
	SAVA-276-S-2001	2001	DOUBLE LICK RUN	1	HIGHLAND	6.76	0.542	10.703	0.284	AD	91.01	4.14	3.89	4.02	1	0
	SAVA-276-S-2002	2002	DOUBLE LICK RUN	1	HIGHLAND	6.46	0.570	11.630	0.547	AD	91.01	3.29	4.56	3.92	1	0
FR-P-288-133-96	UMON-288-S-1996	1996	TRIB TO HUNTING CREEK	1	HIGHLAND	7.33	0.560	6.490	1.700	NONE	88.62	4.14	3.22	3.68	0	0
	UMON-288-S-2000	2000	TRIB TO HUNTING CREEK	1	HIGHLAND	6.52	0.163	3.653	1.603	AD	81.63	2.43	4.33	4.33	1	0
	UMON-288-S-2001	2001	TRIB TO HUNTING CREEK	1	HIGHLAND	6.52	0.396	3.656	0.678	AD	87.89	2.43	4.33	4.33	1	0
	UMON-288-S-2002	2002	TRIB TO HUNTING CREEK	1	HIGHLAND	6.87	0.227	3.190	1.156	AD	87.89	2.43	4.33	3.38	0	0
	UMON-119-S-2002	2002	BUZZARD BRANCH	1	HIGHLAND	7.46	0.189	8.352	2.740	NONE	99.33	2.43	4.56	4.56	1	0

Table D-1. (Continued)

SITE (95-97)	SITENEW	SAM-PLED	STREAM NAME	ORDER	STRATA_R	PH_LAB	NO3_LAB	SO4_LAB	DOC_LAB	ACIDSRC	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
GA-A-432-315-95	YOUG-432-S-1995	1995	BEAR CREEK	3	HIGHLAND	6.96	0.650	9.590	1.000	AD	76.12	4.14	4.11	4.13	1	0
	YOUG-432-S-2000	2000	BEAR CREEK	3	HIGHLAND	7.01	0.788	9.773	2.329	AD	76.25	3.86	4.78	4.32	1	0
	YOUG-432-S-2001	2001	BEAR CREEK	3	HIGHLAND	6.47	1.023	8.589	0.956	AD	76.35	4.14	4.56	4.35	1	0
	YOUG-432-S-2002	2002	BEAR CREEK	3	HIGHLAND	7.11	1.234	9.605	1.439	AD	76.35	4.14	3.89	4.02	1	0

Table D-2. MBSS Sentinel site designated for sampling in 2002

SITE	SAM-PLED	STREAM NAME	ORDER	STRATA_R	PH_ LAB	NO3_ LAB	SO4_ LAB	DOC_ LAB	ACIDSRC	PERCENT FOREST	FIBI	BIBI	CBI	BKTRFLAG	BLACKWAT
CORS-102-S-2001	2001	KIRBY CREEK	1	COASTAL-E	6.56	0.440	8.241	8.682	ORG & AD	89.92	1.75	2.71	2.71	0	1
LOCR-102-S-2001	2001	SWAN CREEK	1	COASTAL-E	5.92	0.169	7.821	20.150	ORG	85.19	2.75	1.86	1.86	0	1
NASS-108-S-2001	2001	MILLVILLE CREEK	1	COASTAL-E	4.36	0.182	5.479	27.625	ORG	77.82	2.25	1.29	1.29	0	1
NASS-302-S-2001	2001	NASSAWANGO CREEK	3	COASTAL-E	6.25	0.252	7.297	12.198	ORG & AD	71.66		3.29	3.29	0	1
UPCK-113-S-2001	2001	SKELETON CREEK	1	COASTAL-E	6.12	0.303	10.977	17.414	ORG & AD	61.00	2.50	2.71	2.71	0	1
WIRH-220-S-2001	2001	LEONARD POND RUN	2	COASTAL-E	6.76	3.860	5.137	3.652	NONE	51.41	3.25	4.43	3.84	0	0
MATT-033-S-2001	2001	MATTAWOMAN CREEK	3	COASTAL-W	6.72	0.115	11.134	3.497	AD	69.69	3.00	3.29	3.14	0	0
NANJ-331-S-2001	2001	MILL RUN	3	COASTAL-W	6.66	0.236	10.836	1.649	AD	81.36	2.50	4.71	3.61	0	0
PAXL-294-S-2001	2001	SWANSON CREEK	2	COASTAL-W	6.94	0.424	14.800	1.864	AD	69.82	3.00	4.14	3.57	0	0
PTOB-002-S-2001	2001	HOGHOLE RUN	2	COASTAL-W	6.59	0.001	9.788	1.523	AD	82.68	4.25	3.86	4.05	0	0
STCL-051-S-2001	2001	UT ST CLEMENTS CREEK	1	COASTAL-W	6.96	0.001	6.558	2.560	NONE	74.93		4.71	4.71	0	0
WCHE-086-S-2001	2001	PLUM POINT CREEK	2	COASTAL-W	7.35	0.229	16.837	2.851	NONE	73.87	1.75	3.00	2.38	0	0
ZEKI-012-S-2001	2001	UT ZEKIAH SWAMP RUN	1	COASTAL-W	6.66	0.214	7.363	1.740	AD	93.04	3.50	4.14	3.82	0	0
FURN-101-S-2001	2001	WINCH RUN (BUCK SWAMP CREEK)	1	EPIEDMNT	6.78	0.622	4.882	3.074	AD	86.46	3.89	4.11	4.00	0	0
JONE-109-S-2001	2001	DIPPING POND RUN	1	EPIEDMNT	6.67	2.921	1.138	1.091	NONE	76.78		4.11	4.11	0	0
JONE-315-S-2001	2001	NORTH BR JONES FALLS	3	EPIEDMNT	8.20	1.522	4.298	1.134	NONE	55.31	3.44	3.00	3.22	0	0
LIBE-102-S-2001	2001	TIMBER RUN	1	EPIEDMNT	7.14	1.272	4.273	1.140	NONE	74.67	3.22	3.44	3.33	1	0
LOCH-120-S-2001	2001	BAISMANS RUN	1	EPIEDMNT	7.14	1.658	2.888	0.790	AD	59.81	2.56	4.33	4.33	1	0
RKGR-119-S-2001	2001	UN TRIB TO PATUXENT R	1	EPIEDMNT	6.81	1.648	5.922	1.077	NONE	65.20	3.44	4.11	3.78	0	0
FIMI-207-S-2001	2001	FIFTEENMILE CREEK	3	HIGHLAND	7.10	0.402	8.793	0.898	AD	89.51	3.57	3.44	3.51	0	0
PRLN-626-S-2001	2001	MILL RUN	2	HIGHLAND	7.67	0.841	12.188	0.879	NONE	100.00	3.86	4.11	3.98	1	0
SAVA-204-C-2001	2001	CRABTREE CR	2	HIGHLAND	7.37	0.707	12.914	0.579	NONE	89.30	3.86	4.33	4.10	1	0
SAVA-225-S-2001	2001	SAVAGE RIVER	3	HIGHLAND	7.22	0.917	10.399	1.173	AD	83.84	4.14	3.67	3.90	1	0
SAVA-276-S-2001	2001	DOUBLE LICK RUN	1	HIGHLAND	6.76	0.542	10.703	0.284	AD	91.01	4.14	3.89	4.02	1	0
UMON-119-S-2002		BUZZARD BRANCH	1	HIGHLAND											
UMON-288-S-2001	2001	TRIB TO HUNTING CREEK	1	HIGHLAND	6.52	0.396	3.656	0.678	AD	87.89	2.43	4.33	4.33	1	0
YOUG-432-S-2001	2001	BEAR CREEK	3	HIGHLAND	6.47	1.023	8.589	0.956	AD	76.35	4.14	4.56	4.35	1	0

Table D-3. MBSS sites sampled in 2002 which met the minimum Sentinel site criteria

SITE	SITE TYPE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_ LAB	NO3_ LAB	SO4_ LAB	DOC_ LAB	ACID SOURCE	PERCENT FOREST	FIBI	BIBI	CBI	BRKTRO UT	BLACK-WAT
LOCR-102-S-2002	SENTINEL	SWAN CREEK	KENT	1	COASTAL-E	5.82	0.072	24.622	15.856	ORG & AD	85.19	2.50	1.86	1.86	0	1
NASS-108-S-2002	SENTINEL	MILLVILLE CREEK	WORCESTER	1	COASTAL-E	4.40	0.032	11.121	18.625	ORG & AD	77.82		1.00	1.00	0	1
NASS-302-S-2002	SENTINEL	NASSAWANGO CREEK	WORCESTER	3	COASTAL-E	6.52	0.001	8.622	10.680	none	71.66	4.25	3.57	3.91	0	0
LOCR-110-R-2002		GRAYS INN CR UT	KENT	1	COASTAL-E	5.80	0.136	30.732	22.013	ORG & AD	56.93		2.43	2.43	0	1
NANJ-331-S-2002	SENTINEL	MILL RUN	CHARLES	3	COASTAL-W	6.60	0.090	9.923	3.144	AD	81.36	4.25	4.71	4.48	0	0
PAXL-294-S-2002	SENTINEL	SWANSON CREEK	CHARLES	2	COASTAL-W	6.83	0.213	15.373	3.770	none	69.82	4.50	4.14	4.32	0	0
PTOB-002-S-2002	SENTINEL	HOGHOLE RUN	CHARLES	1	COASTAL-W	6.62	0.036	7.705	3.662	AD	82.68	4.25	4.71	4.48	0	0
STCL-051-S-2002	SENTINEL	ST CLEMENTS CR UT1	ST. MARY'S	1	COASTAL-W	7.06	0.001	5.584	3.437	none	74.93		4.71	4.71	0	0
WCHE-086-S-2002	SENTINEL	PLUM POINT CREEK	CALVERT	1	COASTAL-W	7.14	0.116	16.182	5.006	none	73.87		3.57	3.57	0	0
ZEKI-012-S-2002	SENTINEL	ZEKIAH SWAMP RUN UT3	CHARLES	1	COASTAL-W	6.81	0.096	8.735	4.136	none	93.04	4.50	4.14	4.32	0	0
BRET-408-R-2002		MACINTOSH RUN	ST. MARY'S	4	COASTAL-W	7.33	0.200	8.195	4.441	none	72.72	2.50	4.71	3.61	0	0
PRMT-118-R-2002		REEDER RUN UT	CHARLES	1	COASTAL-W	6.64	0.055	4.304	4.163	AD	92.16	4.50	3.00	3.75	0	0
PRMT-206-R-2002		REEDER RUN	CHARLES	2	COASTAL-W	6.81	0.128	6.849	4.072	none	91.96	4.50	3.29	3.89	0	0
PRMT-315-R-2002		REEDER RUN	CHARLES	3	COASTAL-W	7.17	0.085	7.946	5.702	none	90.51	4.25	4.14	4.20	0	0
SOUT-108-R-2002		TARNANS BR	ANNE ARUNDEL	1	COASTAL-W	6.10	0.127	12.450	1.536	AD	53.82	5.00	2.43	3.71	0	0
STCL-110-R-2002		ST CLEMENTS CR UT 1	ST. MARY'S	1	COASTAL-W	7.08	0.160	6.137	4.335	none	60.19	4.00	4.14	4.07	0	0
STCL-112-R-2002		TOMAKOKIN CR UT	ST. MARY'S	1	COASTAL-W	6.31	0.374	2.142	4.752	AD	87.56		4.71	4.71	0	0
FURN-101-S-2002	SENTINEL	PRINCIPIO CR UT2	CECIL	1	EPIEDMNT	6.91	0.656	4.620	2.494	AD	86.46	4.11	4.33	4.22	0	0
JONE-109-S-2002	SENTINEL	DIPPING POND RUN UT1	BALTIMORE	1	EPIEDMNT	6.41	3.169	1.246	0.946	none	76.78		3.89	3.89	0	0
JONE-315-S-2002	SENTINEL	NORTH BR JONES FALLS	BALTIMORE	3	EPIEDMNT	8.05	0.960	5.600	1.775	none	55.31	3.44	3.44	3.44	0	0
LIBE-102-S-2002	SENTINEL	TIMBER RUN	BALTIMORE	1	EPIEDMNT	7.01	1.210	4.272	1.210	none	74.67	3.22	4.33	3.78	1	0
LOCH-120-S-2002	SENTINEL	BAISMAN RUN	BALTIMORE	1	EPIEDMNT	7.32	1.594	2.204	1.129	none	59.81		3.67	3.67	1	0
RKGR-119-S-2002	SENTINEL	PATUXENT R UT4	HOWARD	1	EPIEDMNT	7.88	1.599	5.783	1.403	none	65.20	3.22	3.67	3.44	0	0
JONE-101-R-2002		NORTH BR UT 1_UT1	BALTIMORE	1	EPIEDMNT	7.90	2.095	5.162	1.151	none	53.12	2.78	3.89	3.33	0	0
JONE-107-R-2002		NORTH BR	BALTIMORE	1	EPIEDMNT	7.04	0.604	4.942	2.709	none	78.39		4.11	4.11	0	0
JONE-204-R-2002		NORTH BR UT 1	BALTIMORE	2	EPIEDMNT	7.80	2.050	5.063	1.059	none	55.12	2.56	3.89	3.22	0	0
JONE-213-R-2002		JONES FALLS	BALTIMORE	2	EPIEDMNT	7.83	2.045	6.483	1.501	none	59.97	2.56	3.67	3.11	0	0
JONE-303-R-2002		JONES FALLS	BALTIMORE	3	EPIEDMNT	8.05	1.672	12.732	1.752	none	52.77	3.00	3.44	3.22	0	0
LOCH-216-R-2002		OWL BRANCH UT	BALTIMORE	2	EPIEDMNT	7.23	1.766	3.890	1.141	none	60.66		4.56	4.56	1	0
LOGU-202-R-2002		COWEN RUN	BALTIMORE	2	EPIEDMNT	8.07	1.882	12.599	1.811	none	60.46	4.33	3.67	4.00	0	0
RKGR-101-R-2002		ROCKY GORGE RES UT 2	HOWARD	1	EPIEDMNT	7.46	1.579	5.413	2.424	none	52.74	3.22	4.33	3.78	0	0
FIMI-207-S-2002	SENTINEL	FIFTEENMILE CR	ALLEGANY	3	HIGHLAND	7.28	0.256	11.778	1.494	none	89.51	3.86	3.22	3.54	0	0
PRLN-626-S-2002	SENTINEL	MILL RUN (NO)	ALLEGANY	2	HIGHLAND	7.16	1.888	13.214	1.618	none	100.00		4.56	4.56	1	0
SAVA-204-S-2002	SENTINEL	CRABTREE CR	GARRETT	2	HIGHLAND	6.93	0.791	14.104	0.886	AD	89.30		3.67	3.67	1	0
SAVA-225-S-2002	SENTINEL	SAVAGE R	GARRETT	3	HIGHLAND	7.21	0.871	12.284	2.572	AD	83.84		4.33	4.33	1	0
SAVA-276-S-2002	SENTINEL	DOUBLE LICK RUN	GARRETT	1	HIGHLAND	6.46	0.570	11.630	0.547	AD	91.01	3.29	4.56	3.92	1	0
UMON-119-S-2002	SENTINEL	BUZZARD BRANCH	FREDERICK	1	HIGHLAND	7.46	0.189	8.352	2.740	none	99.33		4.56	4.56	1	0
UMON-288-S-2002	SENTINEL	HIGH RUN	FREDERICK	1	HIGHLAND	6.87	0.227	3.190	1.156	AD	87.89	2.43	4.33	3.38	0	0
YOUG-432-S-2002	SENTINEL	BEAR CR	GARRETT	3	HIGHLAND	7.11	1.234	9.605	1.439	AD	76.35	4.14	3.89	4.02	1	0
DOUB-116-R-2002		BIG PIPE CR UT 5	CARROLL	1	HIGHLAND	7.20	1.382	6.477	1.013	none	52.85	2.43	4.56	3.49	0	0
DOUB-407-R-2002		BIG PIPE CREEK	CARROLL	4	HIGHLAND	8.21	3.459	10.063	2.318	none	57.88	2.43	3.89	3.16	0	0
PRMO-112-R-2002		GREEN BRIAR BRANCH	MONTGOMERY	1	HIGHLAND	7.81	0.652	19.127	4.699	none	70.49	3.29	3.89	3.59	0	0
PRMO-114-R-2002		LITTLE MONOCACY R UT 2	MONTGOMERY	1	HIGHLAND	6.72	0.687	6.017	1.601	none	82.65	2.43	3.67	3.05	0	0
PRMO-115-R-2002		LITTLE MONOCACY R UT 2	MONTGOMERY	1	HIGHLAND	6.91	0.695	5.894	1.563	none	76.32	2.71	4.33	3.52	0	0
PRWA-101-R-2002		GREEN SPRING RUN	WASHINGTON	1	HIGHLAND	6.95	0.536	23.920	3.003	none	95.27		3.67	3.67	0	0
PRWA-114-R-2002		POTOMAC R UT 1	WASHINGTON	1	HIGHLAND	7.00	0.203	8.350	2.064	none	66.21		3.44	3.44	0	0
PRWA-206-R-2002		GREEN SPRING RUN	WASHINGTON	2	HIGHLAND	8.11	0.606	18.001	1.581	none	91.14	3.57	2.78	3.17	0	0
SAVA-105-R-2002		BIG RUN WHISKEY HOLLOW UT	GARRETT	1	HIGHLAND	6.87	0.604	8.682	0.711	AD	98.46		4.56	4.56	1	0
SAVA-117-R-2002		BEAR PEN RUN	GARRETT	1	HIGHLAND	6.55	0.600	13.120	0.922	AD	72.86		4.33	4.33	1	0
SAVA-119-R-2002		DRY RUN	GARRETT	1	HIGHLAND	7.18	1.169	13.129	1.067	AD	79.81		4.11	4.11	1	0
SAVA-120-R-2002		TOM'S SPRING RUN	GARRETT	1	HIGHLAND	7.02	0.792	13.169	0.795	none	91.55	3.00	4.33	3.67	1	0

Table D-3. (Continued)

SITE	SITE TYPE	STREAM NAME	COUNTY	ORDER	STRATA_R	PH_ LAB	NO3_ LAB	SO4_ LAB	DOC_ LAB	ACID SOURCE	PERCENT FOREST	FIBI	BIBI	CBI	BRKTRO UT	BLACK- WAT
SAVA-308-R-2002		SAVAGE RIVER	GARRETT	3	HIGHLAND	7.26	0.749	11.632	1.424	AD	83.00	3.86	4.56	4.21	1	0
SAVA-312-R-2002		MIDDLE FORK RUN	GARRETT	3	HIGHLAND	7.02	0.919	13.399	1.299	AD	88.59	3.57	4.56	4.06	1	0
SAVA-401-R-2002		SAVAGE RIVER	GARRETT	4	HIGHLAND	7.39	0.880	13.051	1.523	none	63.33		3.89	3.89	1	0
SAVA-410-R-2002		SAVAGE RIVER	GARRETT	4	HIGHLAND	7.35	0.869	12.744	1.558	none	87.10		3.89	3.89	1	0
SAVA-414-R-2002		SAVAGE RIVER	GARRETT	4	HIGHLAND	7.38	0.870	13.124	1.463	none	87.25		3.44	3.44	1	0
TOWN-205-R-2002		MURLEY BRANCH	ALLEGANY	2	HIGHLAND	7.84	1.635	26.014	2.053	none	61.28	2.14	3.89	3.02	0	0
TOWN-417-R-2002		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.51	0.532	17.396	2.987	none	84.27	3.86	4.11	3.98	0	0
TOWN-419-R-2002		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.67	0.202	13.711	2.194	none	83.40	3.86	4.11	3.98	0	0
TOWN-420-R-2002		TOWN CREEK	ALLEGANY	4	HIGHLAND	7.91	0.194	13.318	2.148	none	83.56	3.86	4.11	3.98	0	0