An Ecological Assessment
of the
Tygart Valley River
Watershed

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Summary

Numerous streams in the Tygart Valley River watershed were assessed during August and September of 1997. Most assessments included measurements of physical attributes of each stream site and associated riparian zone, observations of activities and disturbances in the surrounding area, analyses of water chemistry, and collection of a benthic macroinvertebrate sample. One hundred and twenty-nine benthic samples were collected and scored through the West Virginia Stream Condition Index (WVSCI) rating procedure. WVSCI scores were determined by summarizing the values of six benthic community metrics. Of the 129 benthic collections, 32 were considered impaired, 16 were in the 'gray zone' (considered potentially impaired), and 66 streams scored as being unimpaired. An additional 15 samples were collected via non-comparable methods, so the WVSCI could not be used to score them.

This report attempts to describe the factors that had the largest impacts on the streams in the watershed. The data collected from the streams were compared to data available on the watersheds upstream of the sample points. Landuse maps were used extensively, as were several Geographic Information System (GIS) coverages (e.g., National Pollutant Discharge Elimination System or NPDES permitted facilities, abandoned mine lands, roads, geology, SPOT images, etc.) available from various West Virginia Department of Environmental Protection (WV DEP) offices. Known and suspected associations between impaired benthic communities and upstream landuse activities were identified.

Several streams in the watershed suffered from the effects of mine drainage. Ten sites were impacted by acid mine drainage; six having pH readings below 4.0. An additional 11 of the streams having impaired benthic samples appeared to be primarily impacted by non-acidic mine drainage. There were other stressors at most of these sites as well.

Thirteen of the 18 streams listed on the 1998 version of the 303(d) list of streams impaired by acid rain were sampled as part of this assessment. However, only four of these streams produced low pH measurements at the time of sampling. This does not mean the other nine did not suffer from acidic deposition, since low pH due to atmospheric acid inputs is often a cold season phenomenon. Another stream, Phillips Camp Run, should be considered for addition to future lists.

Five sites showed signs of nutrient enrichment. These sites had one or more of the following characteristics: depressed WVSCI scores, heavy periphyton growth, or benthic communities dominated by taxa tolerant of organic enrichment. These streams were typically located within areas having high percentages of agricultural land use.

Poor stream and riparian habitats were considered primary reasons for impairment of the benthic communities at several sites. The habitats at these sites had been degraded by a combination of poor

mining and logging practices, road construction too close to the stream banks, and inappropriate land management practices by some landowners.

Water samples were collected at each site to measure the concentration of fecal coliform bacteria. Forty-five of 134 samples had results with 400 or more colonies per 100 mL sample. Ten of these sites had values of over 2,000 colonies per 100 mL sample.

It is encouraging to note that there were also many healthy streams in the watershed. The headwater portions of the watershed are within the boundary of Monongahela National Forest, and there are large expanses of undeveloped land in other parts of the watershed as well. Six of the Watershed Assessment Section's current total number of statewide reference sites (239) are within this watershed. In addition to these six sites that met each of the Watershed Assessment Section's reference site criteria, there were 27 sites that had benthic communities favorably compared to those of the reference sites.

Acknowledgments

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Jeffrey Bailey, Christina Moore, Perry Casto, Alvan Gale, John Wirts, Mike Puckett, Charles Surbaugh, George Constantz, and Douglas Wood collected the samples and assessed the sites.

Marshall University Students, Eric Wilhelm and Andrea Henry, under the supervision of Dr. Donald Tarter and Jeffrey Bailey, processed the benthic samples. Jeffrey Bailey, Janice Smithson, John Wirts, Douglas Wood, and Alvan Gale identified the benthic macroinvertebrates. John Wirts created the tables and figures. Jeffrey Bailey and John Wirts were the primary authors. Michael Arcuri, Patrick Campbell, Ben Lowman, Janice Smithson, Jessica Greathouse, Steve Stutler, and Doug Wood provided help in reviewing the various drafts of this report and bringing it to completion. John Wirts designed the layout and Doug Wood provided finishing touches to the report.

Watersheds and Their Assessment

In 1959, the West Virginia Legislature created the State Water Commission, the predecessor of the Division of Water and Waste Management (DWWM). The DWWM has since been charged with balancing the state's needs of economic development and water consumption with the restoration and maintenance of water quality in the state's waters.

At the federal level, the U.S. Congress enacted the Clean Water Act of 1972 and subsequent amendments in order to restore the quality of our nation's waters. For over 30 years, the Act's National Pollutant Discharge Elimination System (NPDES) has caused reductions in pollutants piped to surface waters. There is broad agreement that because NPDES permits have reduced the amount of contaminants in point source discharges, the water quality of many of our nation's streams has improved significantly.

Under the federal law, each state was given the option of managing NPDES permits within its borders or deferring that management role to the federal government. When West Virginia assumed primacy over NPDES permits in 1982, the state's Water Resources Board - renamed the Environmental Quality Board (EQB) in 1994 - began developing water quality criteria for each kind of use designated for the state's waters (see box). In addition, the WV Department of Environmental Protection's (DEP) water protection activities are guided by the EQB's anti-degradation policy, which charges the DWWM with maintaining surface waters at sufficient quality to support existing uses, regardless of whether or not the uses are specifically designated by the EQB.

Even with significant progress, by the early 1990s many streams still did not support their designated uses. Consequently, environmental managers began to examine pollutants flushing off of the landscape from a broad array of sources. Recognition of the negative impacts of these Non-Point Sources (NPS) of pollution, was a conceptual step that served as a catalyst for today's holistic watershed approach to improving water quality.

Several DEP units, including the Watershed Assessment Section (referred to herein as "the Section"), are currently

WATER QUALITY CRITERIA - The concentrations of water quality parameters and the stream conditions that are required to be maintained by the Code of State Regulations, Title 46, Series 1 (Requirements Governing Water Quality Standards).

DESIGNATED USES - For each water body, those uses specified in the water quality standards, whether or not those uses are being attained. Unless otherwise designated by the rules, all waters of the state are designated for:

- the propagation and maintenance of fish and other aquatic life, and
- water contact recreation.

Other types of designated uses include:

- public water supply,
- agriculture and wildlife uses, and
- industrial uses.

implementing a variety of watershed projects. Located within the DWWM, the Section's scientists are charged with evaluating the health of West Virginia's watersheds. The Section is guided, in part, by the Interagency Watershed Management Steering Committee (see box).

The Section uses the U.S. Geological Survey's (USGS) scheme of hydrologic units to divide the state into 32 watersheds. Some of these watersheds are entire stream basins with natural hydrologic divides (e.g., Gauley River watershed). Three other types of watershed units were devised for manageability: (1) clusters of small tributaries that drain directly into a larger mainstem stream (e.g., Potomac River Direct Drains watershed); (2) the West Virginia portions of interstate basins (e.g., Tug Fork watershed); and (3) divisions of large watersheds (e.g., Upper and Lower Kanawha River watersheds).

THE INTERAGENCY WATERSHED MANAGEMENT STEERING COMMITTEE consists of representatives from each agency that participates in the Watershed Management Framework. Its function is to coordinate the operations of the existing water quality programs and activities within West Virginia to better achieve shared water resource management goals and objectives.

The Watershed Basin Coordinator serves as the day-to-day contact for the committee. The Coordinator's responsibilities are to organize and facilitate the steering committee meetings, to maintain the watershed management schedule, to assist with public outreach, and to be the primary contact for watershed management related issues.

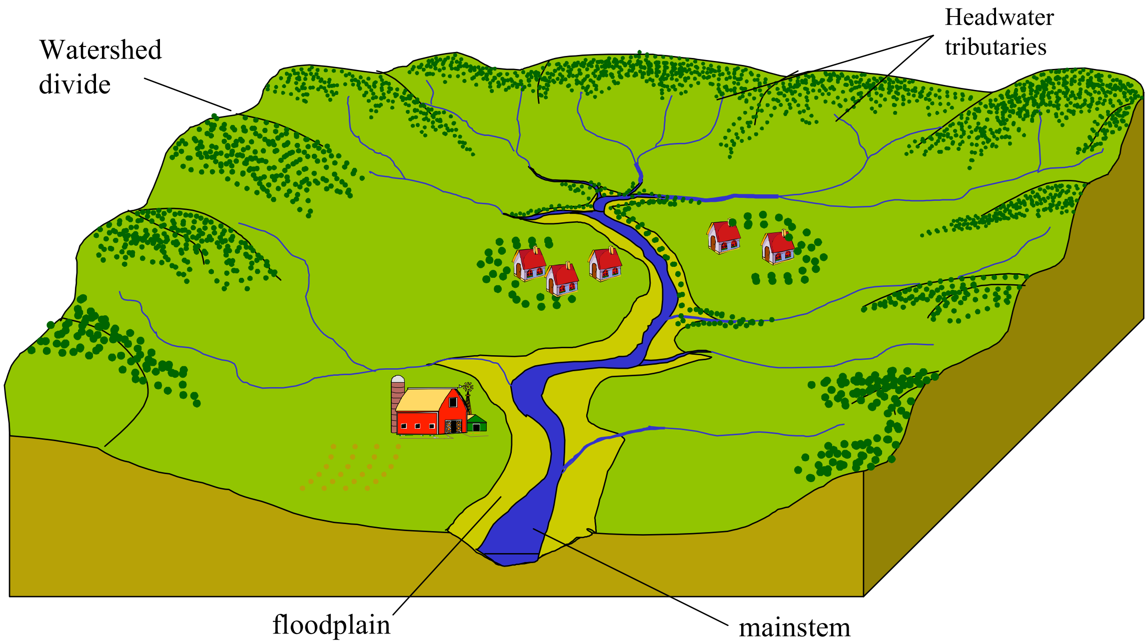
One goal of the Section is to assess each watershed unit every five years, an interval coinciding with the reissue of NPDES permits within each assessed watershed.

General Watershed Assessment Strategy

A watershed may be envisioned as an aquatic tree, that is, a network of upwardly branching, successively smaller streams. An ideal assessment of a watershed would be one that documented changes in the quantity and quality of water flowing down every stream, at all water levels, in all seasons, from headwater reaches to the downstream boundary of the watershed. Land uses throughout the watershed would also be quantified. It is obvious this approach would require more time and resources than are usually available.

The Section assesses the health of a watershed by evaluating the aquatic integrity of as many streams as possible near their mouths. The general sampling strategy can be broken into several steps:

Figure 1. A Generalized Watershed



In this report, "watershed" refers to all of the land that drains to a certain point on a river. In the case of the Tygart Valley River watershed, it includes all of the land (about 410,540 acres) that drains to the mouth of Tygart Valley River in Fairmont, WV.

- The names of streams within the watershed are retrieved from the U. S. EPA's Waterbody System database.

- A list of streams is developed that consists of several sub-lists, including:
  1. Severely impaired streams,
  2. Slightly or moderately impaired streams,
  3. Unimpaired streams,
  4. Unassessed streams, and
  5. Streams of particular concern to citizens.

- Assessment teams visit as many listed streams as possible and sample as close to the streams' mouths as allowed by road access and sample site suitability.

Long streams may be sampled at additional sites further upstream. In general if a stream is 15 to 30 miles (25-50 km) long, two sites are sampled; 30-50 miles (50-89 km) long, three sites are sampled; 50-100 miles (80-160 km) long, four sites are sampled or; longer than 100 miles (160 km), five sites are sampled. If inaccessible or unsuitable sites are dropped from the list, they are replaced with previously determined alternate sites.

An exception to this general investigative strategy is the sampling methodology developed to produce statistically valid summaries that allow the comparison of watersheds to one another. This methodology is detailed in the section titled "*Probabilistic or Random Sampling*."

The Section has scheduled the assessment of each watershed during a specific year of a five-year cycle. Advantages of this preset timetable include: 1) synchronizing study dates with permit cycles, 2) facilitating the addition of stakeholder input to the information gathering process, 3) insuring assessment of all watersheds, and 4) improving the DWWM's ability to plan.

In a broad sense, the DWWM's Watershed Assessment Section evaluates streams while the Interagency Watershed Management Steering Committee (see side-bar on page 9) sets priorities in each watershed.

This document, which reports findings for the Tygart Valley River watershed, has been prepared for a wide variety of users, including elected officials, environmental consultants, educators, watershed associations, and natural resources managers.

Probabilistic (Random) Sampling

The nonrandom sampling component of the watershed assessment process incorporates a potentially biased site selection procedure. Nonrandom sites are generally sampled at locations with easy access, generally near the mouths of streams and at road crossings. An assessment of these sites alone does not provide a balanced evaluation of an entire watershed.

In 1997, in order to improve the evaluation process, the Section began to incorporate random sampling into the watershed assessment strategy. The sample sites are randomly selected by computer and may require an assessment at any point along the length of the stream. Random sampling allows statistically valid inferences of stream conditions within each watershed to be made. Randomization also improves comparisons between watersheds. U.S. EPA personnel provide locations for about 40 random sites within each watershed. Because there are many more miles of first-order and second-order headwater streams than there are of higher ordered streams, stream miles are statistically weighted so that an adequate number of larger stream sites are selected by the computer.

TOTAL MAXIMUM DAILY LOAD AND THE 303(d) LIST - The term "total maximum daily load" (TMDL) originates in the federal Clean Water Act, which requires that degraded streams be restored to support their designated uses.

Every two years, a list of water quality limited streams, called the 303(d) list after the Clean Water Act section number wherein the list is described, is prepared. In a case of severe impairment, it is relatively easy to determine that a stream should be placed on the 303(d) list. However, the determination is more difficult to make for most streams due to a lack of data or data that are conflicting, of questionable quality, or too old. Any stream that would not support its designated uses, even after technology-based pollution controls were applied, would be considered for inclusion on the list. West Virginia's 303(d) list includes streams affected by a number of stressors including mine drainage, acid deposition, metals, and siltation.

Mathematically, a TMDL is the sum of the allocations of a particular pollutant (from point and nonpoint sources) into a particular stream, plus a margin of safety. Restoration of a 303(d) list stream begins by calculating a TMDL, which involves several steps:

- Define when a water quality problem is occurring (e.g., at base flow, during the hottest part of the day, or throughout the winter ski season),
- Calculate how much of a particular contaminant must be reduced in a stream in order to meet the appropriate water quality criterion,
- Calculate the total maximum daily load from flow values during the problem period and the concentration allowed by the criterion,
- Divide the total load allocation between point and nonpoint sources (e.g., 70% point and 30% nonpoint), and
- Recommend pollution reduction controls to meet designated uses (e.g., install best management practices, reduce permit limits, or prohibit discharges during problem periods).

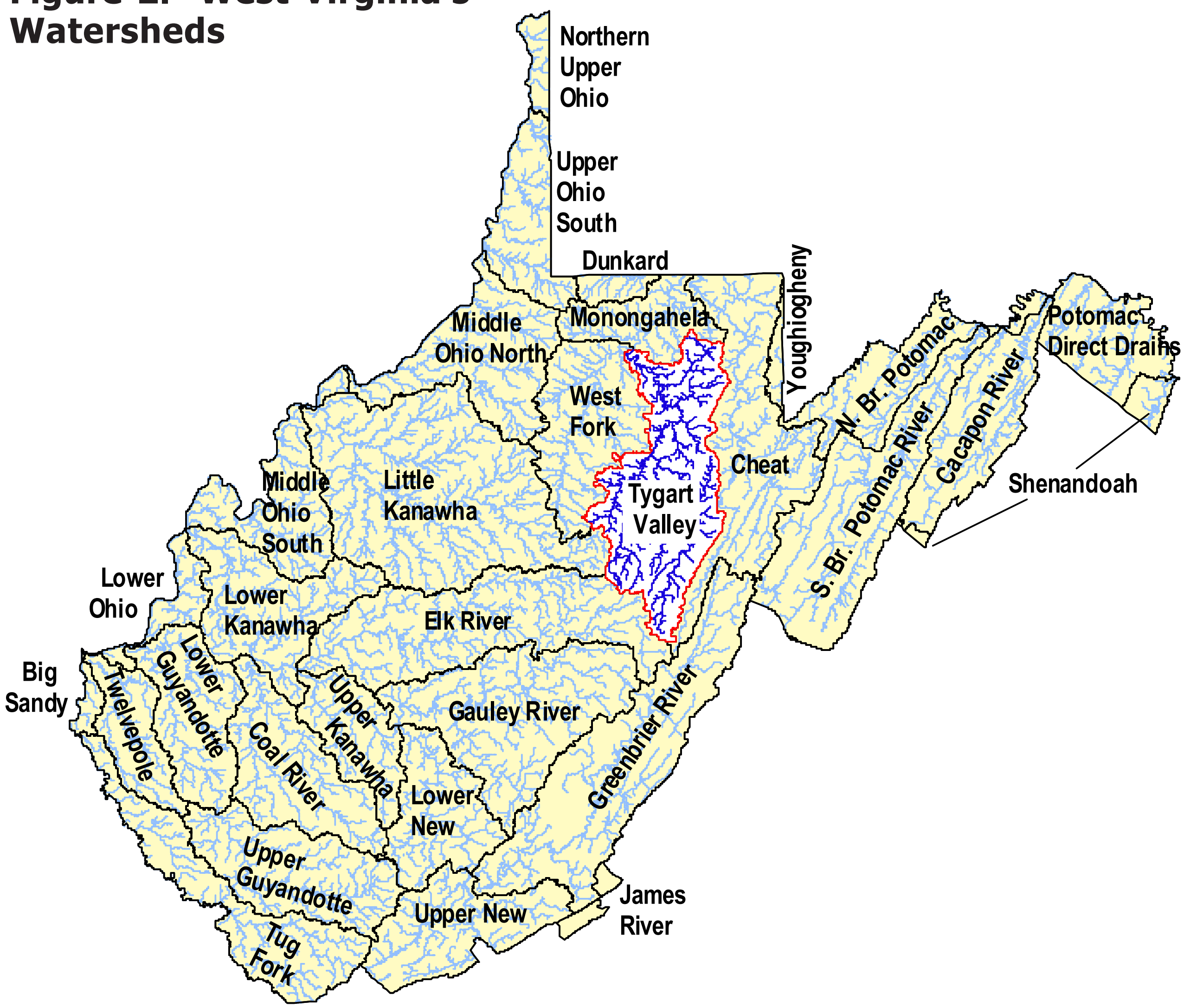
Section field crews visit the sites and verify their locations with Geographic Positioning System (GPS) units. If a site is wadeable and has riffle/run habitat, it is assessed using the same protocols as those used at nonrandom sites with the addition of extra water quality constituents to the analysis list.

The Tygart Valley River Watershed

The Tygart Valley River (HUC # 05020001) and many of its larger tributaries generally flow from south to north, west of the highest mountains in West Virginia (Fig. 2). Along its longest transect (north to south), the watershed is roughly 76 miles across. However, the river mainstem flows about 133 miles from its headwaters to its mouth. The river originates in the mountains near the communities of Valley Head and Mingo in Pocahontas County, and generally flows northward. This watershed drains approximately 1,374 square miles (879,656 acres) in Pocahontas, Randolph, Webster, Upshur, Lewis, Barbour, Tucker, Taylor, Preston, Marion, and Monongalia Counties.

The Middle Fork River and the Buckhannon River are the two largest tributaries of the Tygart

Figure 2. West Virginia's Watersheds



Valley River. Another significant hydrologic system located within the watershed is Tygart Lake, a U.S. Army Corps of Engineers impoundment near Grafton in Taylor County. The Lake is formed by a 230-foot high dam and has a maximum capacity of 286,600 acre-feet.

The elevation in the watershed ranges from a high of over 4,800 feet in Pocahontas County, to a low of 857 feet where the Tygart Valley River joins the West Fork River at Fairmont to form the Monongahela River. The morphology of the river alternates between rough/turbulent and placid/quiet along its entire length. This variable morphology makes it difficult to describe the river in generalities.

The Tygart Valley River watershed includes parts of three Level III ecoregions: the Ridge &

Figure 3. Ecoregions overlapping the Tygart Valley River Watershed

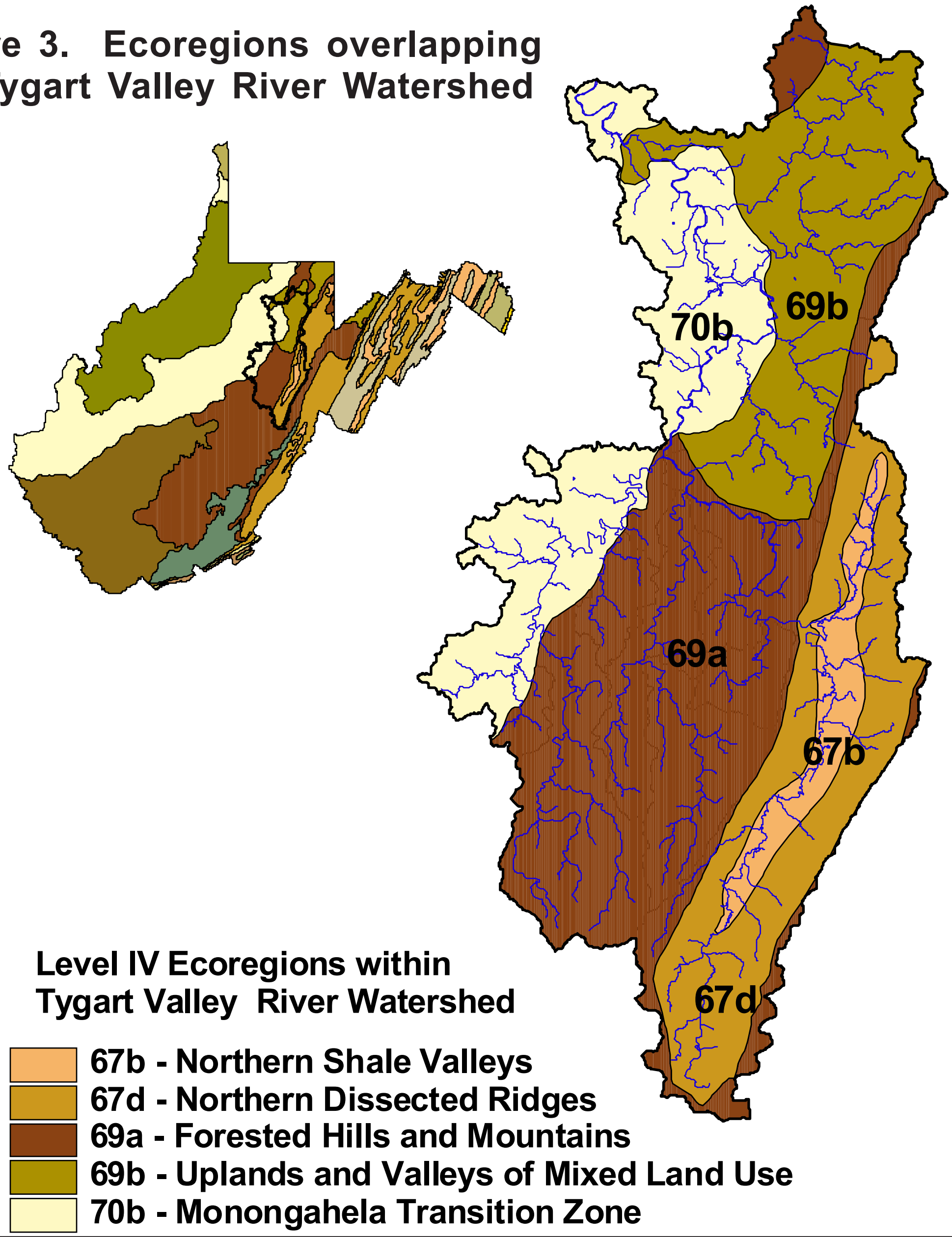
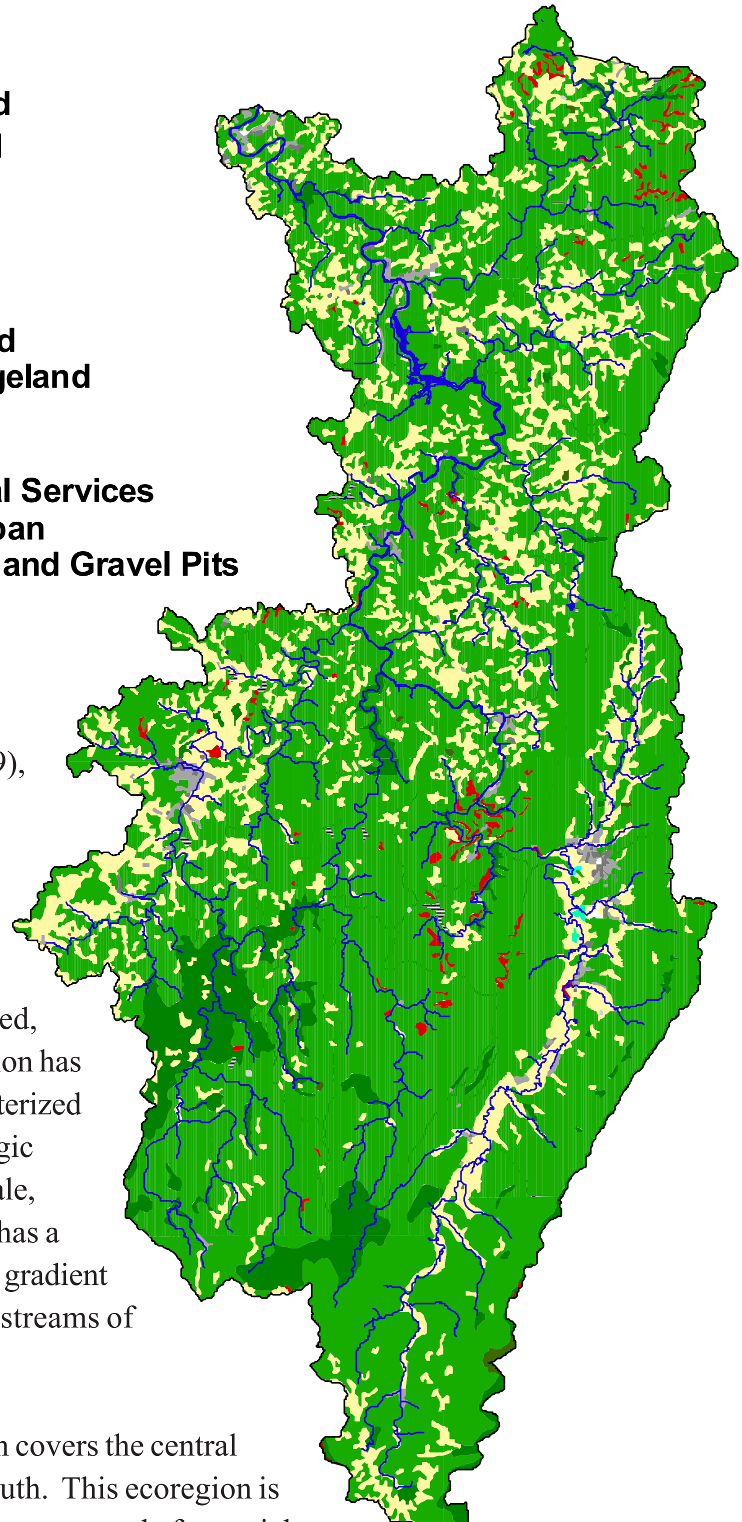


Figure 4. Landuses of the Tygart Valley River Watershed



Valley (67), the Central Appalachians (69), and the Western Allegheny Plateau (70) (Omernik, et. al., 1997). These ecoregions are further divided into Level IV ecoregions as shown in Figure 3. The Ridge & Valley ecoregion generally covers the eastern portion of the watershed, mostly in Randolph County. This ecoregion has roughly parallel ridges and valleys characterized by a variety of widths, heights, and geologic materials such as limestone, dolomite, shale, siltstone, and sandstone. The ecoregion has a diversity of aquatic habitats from the high gradient streams of the steep slopes to the slower streams of the valley areas.

The Central Appalachians ecoregion covers the central portion of the watershed from north to south. This ecoregion is primarily a high, dissected, rugged plateau composed of materials such as conglomeratic sandstone, shale, and coal. Agricultural activities are generally limited to hay and pasture in this ecoregion as a result of its rugged terrain, cool climate, and infertile soils.

The Western Allegheny Plateau ecoregion covers the western portion of the Tygart Valley River watershed. This ecoregion is often described as hilly and wooded. It is less rugged and forested than the ecoregions to the east and south. However, the uplands are highly dissected by streams in a dendritic drainage pattern. Underlying geology is generally sedimentary rock that has been mined for coal.

Climate is varied across the watershed, but is typified by relatively moderate summertime temperatures with adequate annual precipitation for maintaining flows year-around in sub-watersheds of less than 200 acres. Fairmont, a city at the lowest reach of the watershed has recorded seasonal temperature extremes over 100° Fahrenheit and below minus 20°F. Winters can be very cold, especially on the higher mountaintops. Freezing temperatures often occur as early as September 20 and as late as May 20. There have been freezing temperatures and snow recorded during every month in the higher mountains. In 1996, the year before this study was conducted, Elkins, a community within the southeastern quadrant of the watershed, recorded over 70 inches of precipitation. The headwaters of Buckhannon River lie in a region of West Virginia that receives a higher average annual precipitation than any other part of the state.

Human Population and Land Use

The largest human population centers in the Tygart Valley River watershed are Elkins (population 7,420), Grafton (population 5,524), Buckhannon (population 5,909), Philippi (population 3,132), and Belington (population 1,850). Fairmont has a population of 20,210, only part of which reside in the Tygart Valley River watershed. All of these communities and many smaller ones have central sewage collection systems. However, many of these old collection systems are plagued by infiltration/inflow, thus rendering treatment processes inadequate during precipitation events.

Current land uses in the Tygart Valley River watershed consist of a mixture of coal mining, timber harvesting, agriculture, oil/gas extraction, quarrying, and recreational activities. Since the 19th century, industrial activities in the central and lower portions of the watershed included primarily coal mining, agriculture, and logging. The upper watershed has had less coal mining but a good deal of logging. Agriculture is fairly common in the valleys throughout the watershed and, in the central and lower portions of the watershed, rounded ridges also provide suitable sites for pasture and hay. Commercial use of the steeper slopes and ridges is mostly limited to logging. The entire Tygart Valley River watershed has been timbered at least once since the Civil War.

There are numerous opportunities for outdoor recreation in the Tygart Valley watershed including hunting, fishing, hiking, camping, and picnicking. National forest land encompasses about 23,600 acres and Kumbrabow State Forest offers nearly 9,500 acres. Tygart Lake State Park, Audra State Park, and Valley Falls State Park are also located within the watershed.

Watershed Assessment Methods

In 1989, the U.S. EPA published a document titled *Rapid Bioassessment Protocols for Use in Streams and Rivers - Benthic Macroinvertebrates and Fish* (Plafkin et al. 1989). This document was intended to provide water quality monitoring programs, such as the Section's Watershed Assessment Program, with a practical technical reference for conducting cost-effective biological assessments of flowing waters.

Originally, the Rapid Bioassessment Protocols (RBP) were intended to be inexpensive screening tools to determine if a stream was supporting a designated aquatic life use. However, the current consensus is that the RBPs can also be applied to other program areas, such as:

- Characterizing the existence and severity of use impairment
- Helping to identify sources and causes of impairments in watershed studies
- Evaluating the effectiveness of control actions
- Supporting use-attainability studies
- Characterizing regional biological components.

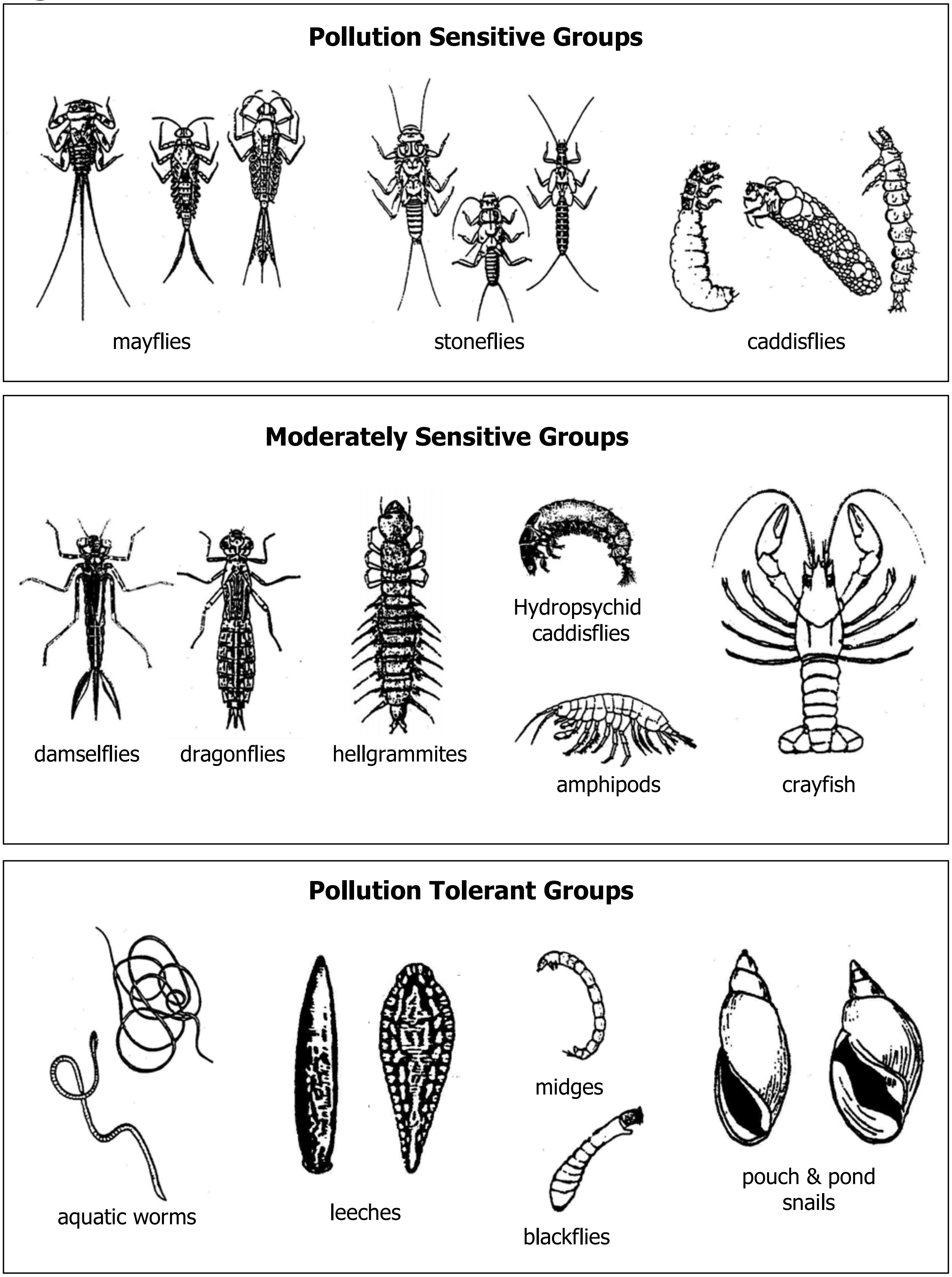
The diversity of applications provided by the RBPs was the primary reason they were adopted by the Section for use in assessing watersheds. In 1999, the EPA published a second edition of the RBP manual (Barbour, et. al.,1999). Before this publication date, a draft revision was circulated among the states and the Section was able to incorporate many of the recommended changes to protocol prior to the 1998 sampling season. The changes were minor, consisting primarily of a reconfiguration of the habitat assessment procedure and a different means of categorizing levels of effort for the benthic collections. Because the vast majority of stream miles in the state have riffle/run habitat, the "Single Habitat Approach" was the benthic collection method adopted by the Section.

The following sections summarize the procedures used to assess the streams in this watershed. A more detailed description of assessment procedures is found in the Watershed Assessment Section's *Standard Operating Procedures* manual (Smithson 1997).

Biological Monitoring — Benthic Macroinvertebrates

Benthic macroinvertebrates are small animals that live on the bottom of streams, rivers, and lakes. Insects comprise the largest diversity of these animals and include mayflies, stoneflies, caddisflies, beetles, midges, crane flies, dragonflies, and others. Snails, mussels, aquatic worms, and crayfish are also members of the benthic macroinvertebrate community. Benthic macroinvertebrates are important in the processing and cycling of nutrients, and are major food sources for fish and other aquatic animals. In general, a clean stream has a diverse array of benthic organisms that occupy a variety of ecological niches. Polluted streams generally have a lower diversity and often are devoid of pollution sensitive species. Figure 5 shows several of the most common macroinvertebrate organisms found in

Figure 5. Common Benthic Macroinvertebrates



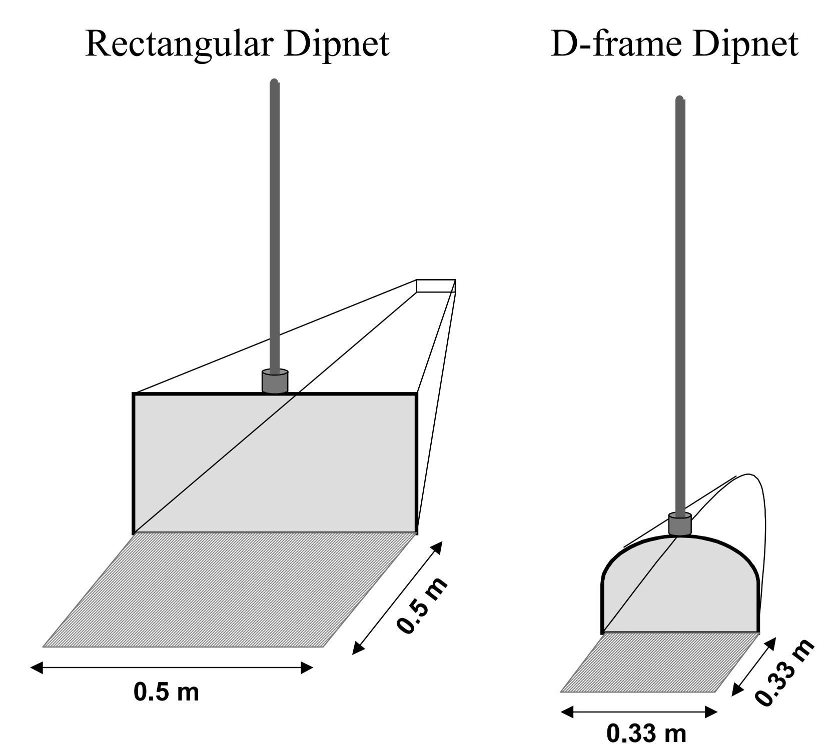
West Virginia's streams.

Benthic macroinvertebrate data have been used for several decades as tools for conducting ecological assessments of streams. Many federal, state, and private organizations use this group of animals as part of their biological monitoring programs and the advantages are myriad. The most recognized benefit is that benthic macroinvertebrate communities reflect overall ecological integrity (i.e., chemical, physical, and biological integrity). They provide a holistic measure of environmental conditions by integrating responses to stresses over time, and the public better understands them (as opposed to chemical conditions) as measures of environmental health (Plafkin et al. 1989).

Benthic macroinvertebrates can be collected using several techniques. The Section used the EPA's RBP II with some modifications. The two-man kick net used in the original RBP was replaced with a kick net modified for use by one person. In streams having adequate riffle/run habitat, the Section used a rectangular dipnet to capture organisms dislodged by kicking the stream bottom substrate and by brushing large rocks and sticks. In streams too small to accommodate the rectangular dipnet, a smaller net called a D-frame was used to collect dislodged organisms (See Figure 6). Riffle/run streams with low flow that did not have enough water to sample with either net were sampled using a procedure called hand picking. This procedure involved picking and washing stream substrate materials in a bucket of water. Field crews attempted to sample 2 square meters of stream substrate (an area equal to 8 kicks with a rectangular net and 18 with a D-frame net) regardless of the device or technique employed.

The D-frame net was used also to collect macroinvertebrates in slow flowing (glide/pool dominated) streams that did not have sufficient riffle/run habitat. Macroinvertebrate sampling in glide/pool streams was accomplished using a procedure developed for use in

Figure 6. Benthos Collection Nets



0.5 x 0.5 = 0.25m
0.25 x 8 kicks = 2.0 m^2

0.33 x 0.33 = 0.109
0.109 x 18 kicks = ~2.0 m^2

sluggish coastal streams. The sampling procedure is called the Mid-Atlantic Coastal Streams technique (MACS) and consists of sampling a variety of habitats (aquatic plants, woody debris, undercut stream banks, etc.) through sweeping and jabbing motions of the net (Maxted 1993).

Benthic macroinvertebrate samples were preserved and delivered to the Department of Biological Sciences at Marshall University for processing. Processing involved removing a 100-organism subsample from the composite sample following RBP II protocols. The subsample was returned to Section biologists who counted and identified the specimens to the family level or the lowest possible level of classification. The samples were kept for future reference and for identification to lower taxonomic levels if necessary.

Fish specimens inadvertently collected during macroinvertebrate sampling were transferred to the WV Department of Natural Resources (DNR) office in Elkins, West Virginia where they became part of the permanent fish collection. Salamanders inadvertently collected were donated to the Marshall University Biological Museum in care of Dr. Tom Pauley.

The Section's primary goal in collecting macroinvertebrate data was to determine the biological conditions of the selected stream assessment sites. Determining the biological condition of each site involved calculating and summarizing six community metrics based upon the benthic macroinvertebrate data. The following benthic community metrics were used for each assessment site:

Richness Metrics

1. Total Taxa - measures the total number of different macroinvertebrate taxa collected in the sample. In general, the total number of taxa increases with improving water quality.

2. EPT Index - measures the total number of distinct taxa within the generally pollution sensitive orders *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies). In general, this index increases with improving water quality.

Community Composition Metrics

3. Percent Contribution of 2 Dominant Taxa -

Benthic Community Metrics

Metrics are calculations that numerically describe the benthic communities of streams. Some metrics are simple summations such as Taxa Richness; a measure of the total number of different kinds of organisms in a sample.

Other metrics are more complex such as Hilsenhoff's Biotic Index, which incorporates the pollution tolerance values of collected organisms to provide a number that assesses organic pollution in streams.

The Section currently uses six metrics to determine the integrity of benthic macroinvertebrate communities. The use of several metrics, instead of only one or two, provides greater assurance that valid assessments of integrity are made.

measures the abundance of the two numerically dominant taxa relative to the total number of organisms in the sample. Generally, this index decreases with improving water quality.

4. Percent EPT - measures the relative abundance of mayfly, stonefly, and caddisfly individuals to the total number of organisms in the sample. In general, this index increases with improving water quality.

5. Percent *Chironomidae* - measures the abundance of chironomid (midge) individuals relative to the total number of individuals in the sample. Generally, chironomids are considered tolerant of many pollutants. This metric generally decreases in value with improving water quality.

Tolerance/Intolerance Metric

6. HBI (Hilsenhoff's Biotic Index - modified) - summarizes tolerances of the benthic community to organic pollution. Tolerance values range from 0 to 10 and generally decrease with improving water quality.

Of the many metrics available, these six metrics were used because (1) they provide the best discrimination between impaired and unimpaired sites, (2) they represent different community attributes, and (3) they minimize redundancy.

West Virginia Stream Condition Index

The six benthic community metrics were combined into a single index, the West Virginia Stream Condition Index (WVSCI). The WVSCI was developed by Tetra Tech Inc. (Gerritsen et. al. 2000) using the WVDEP's watershed assessment data collected from riffle/run habitats in wadeable streams.

The WVSCI score is determined by calculating the average of the standardized score of each metric. The standardized score for each metric is determined by comparing an individual metric value to the "best standard value". This value represents either the 95^{th} or 5^{th} percentile (depending on whether the metric registers high or low for healthy streams) of all sites sampled via comparable methods. In general terms, all metrics values are converted to a standard, 0 to 100 (worst to best) scale. An average of the six standardized metric scores is calculated for each benthic sample site resulting in a final index score that ranges from 0 to 100.

In order to interpret the WVSCI score, the Section needed to establish reference conditions (see side-bar). In previous assessments, the Section used either a single least-impaired site or a set of sites categorized by both stream width and ecoregional location as the reference conditions. However, it soon became clear that it is difficult to identify a single reference site that has both (1) minimal impairment and (2) the type of biological community that provides defensible conclusions about the impairment of assessed sites.

As a result of this revelation, the Section began defining reference conditions by using a collection of sites that met predetermined minimum impairment criteria. A site's suitability as a reference site was established by comparing the site's habitat and physicochemical data to a list of minimum degradation criteria or "reference site" criteria. Assessment sites that met all of the minimum criteria were given reference site status. The Section developed the minimum degradation criteria with the assumption that sites meeting these criteria would provide a reasonable approximation of least disturbed conditions.

Originally, the Section was using a set of reference sites limited to the watershed being studied. Subsequent research showed that a single reference set for wadeable streams is sufficient for statewide assessments (Gerritsen et. al. 2000). The researchers found that partitioning streams into ecoregions did not significantly improve the accuracy of assessments. The Section began using over 200 reference sites to describe reference conditions. The reference conditions were then used to establish a threshold for biological impairment. These reference conditions can be used statewide, in all wadeable streams, and throughout the established sampling period of April through October.

Reference Conditions

Reference conditions describe the characteristics of waterbody segments least-impaired by human activities, and are used to define attainable biological and habitat conditions. Selection of reference sites depends on an evaluation of the physicochemical and habitat data collected during each site's assessment.

These data must meet minimum degradation criteria established by the Section before a site can be given reference site status. In general, the following parameters are examined: dissolved oxygen, pH, conductivity, fecal coliform bacteria, violations of water quality standards, non-point sources of pollution, benthic substrate, channel alteration, sediment deposition, streambank vegetation, riparian zone vegetation, overall habitat condition, human disturbances, point sources of pollution, and land use.

The information from sites that meet the defined criteria is used to establish reference conditions. Benthic macroinvertebrate data from each assessment site can then be compared to the reference conditions to produce a WVSCI score.

The 5th percentile of the range of WVSCI scores for all the reference sites was selected as the impairment threshold. For the 107 reference sites used in this study, the 5th percentile score is 68. Initially, a site that received a WVSCI score equal to or less than 68 was considered impaired. However, because the final WVSCI score can be affected by a number of factors (collector, microhabitat variables, subsampling, etc.) the Section sampled 26 sites in duplicate to determine the precision of the scoring. Following an analysis of the duplicate data, the Section determined the precision estimate to be 7.4 WVSCI points. The Section then subtracted 7.4 points from the impaired threshold of 68 and generated what is termed the gray zone that ranges from >60.6 to 68.0. If a non-reference site has a WVSCI score within the "gray zone", a single kick sample is considered insufficient for classifying it as impaired. If a site produces a WVSCI score equal to or less than 60.6, the Section is confident that the site was truly biologically impaired during the assessment period based on the single benthic macroinvertebrate sample. Accordingly, sites receiving the lowest WVSCI scores are the most impaired.

The impairment categories developed within the WVSCI are important tools the Section uses in making management decisions and in allocating limited resources to the streams that need them most. For the purposes of this report, the Section considered impaired sites and sites with WVSCI scores in the gray zone to be in need of further investigation and/or corrective action.

Fecal Coliform Bacteria

Numerous disease-causing organisms may accompany fecal coliform bacteria, which is released to the environment in feces. Therefore, the presence of such bacteria in a water sample indicates the potential presence of human pathogens.

A fecal coliform bacteria sample was collected at each assessment site. EPA sampling guidelines limit the field holding time for such samples to 6 hours. Due to the distance to laboratories, personnel limitations, and time constraints, a 24-hour limit was utilized during this sampling effort. All bacteria samples were packed in wet ice until delivered to the laboratory for analysis.

Physicochemical Sampling

Physicochemical samples were collected at each site to help determine what types of stressors, if any, were negatively impacting each benthic macroinvertebrate community. The physicochemical data were helpful in providing clues about the sources of stressors.

Field analyses for pH, temperature, dissolved oxygen, and conductivity were performed. The manufacturer's calibration guidelines for each measurement instrument were followed with minimal variation except that the instruments were generally not calibrated at the end of each sampling day.

Samples were collected at many sites for analysis of specific water quality constituents. A list of these constituents, preservation procedures, and analytical methods is included in Table 1.

In areas where mine drainage was present, assessment teams collected water samples for the analyses of aluminum (Al), iron (Fe), and manganese (Mn). In a few cases, samples were analyzed for

Table 1. Water Quality Parameters

All numbered references to analytical methods are from *EPA: Methods for Chemical Analysis of Water and Wastes; March 1983*, unless otherwise noted.

Parameter	Minimum Detection Limit or Instrument Accuracy	Analytical Method	Maximum Holding Time
Acidity	5 mg/L	305.1	14 days
Alkalinity	5 mg/L	310.1	14 days
Sulfate	5 mg/L	375.4	28 days
Iron	200 µg/L	200.7	6 months
Aluminum	100 µg/L	200.7	6 months
Manganese	10 µg/L	200.7	6 months
Fecal Coliform Bacteria	Not Applicable	9222 D[1]	24 hours[2]
Conductance	1% of range[3]	Hydrolab™	Instant
pH	± 0.2 units[3]	Hydrolab™	Instant
Temperature	± 0.15 C[3]	Hydrolab™	Instant
Dissolved Oxygen	± 0.2 mg/L[3]	Hydrolab™	Instant
Total Phosphorus	0.02 mg/L	4500-PE[1]	28 days
Nitrite+Nitrate-N	0.5 mg/L	353.3	28 days
Ammonia-N	0.5 mg/L	350.2	28 days
Unionized Amm-N	0.5 mg/L	350.2	28 days
Suspended Solids	5 mg/L	160.2	28 days
Chloride	1 mg/L	325.2	28 days

[1] Standard Methods For The Examination Of Water And Wastewater, 18th Edition, 1992.

[2] U. S. EPA guidelines limit the holding time for these samples to 6 hours. Due to laboratory location, personnel limitations and time constraints, 24 hours was the limit utilized during this sampling effort.

[3] Explanations of and variations in these accuracies are noted in Hydrolab Corporation's Reporter ™ Water Quality Multiprobe Operating Manual, May 1995, Application Note #109.

hot acidity (mg/L), alkalinity (mg/L), and sulfate (mg/L). If excess nutrients were suspected, total phosphorus, nitrate+nitrite nitrogen, and ammonia were included in the analyses.

Assessment teams measured stream flow in cubic feet per second (cfs) when field readings indicated there was mine drainage impacting the stream. A current meter was used across a stream transect and the discharge was calculated with the sum-of-partial-discharges method.

The collection, handling, and analysis of water samples generally followed procedures approved by the EPA. Field blanks for water sample constituents were prepared on a regular basis by each assessment team. The primary purpose of collecting field blanks was to check for contamination of preservatives, containers, and sample water during sampling and transportation. A secondary purpose was to check the precision of analytical procedures.

Habitat Assessment

An eight-page Stream Assessment Form was completed at each site. A 100 meter section of stream and the land in its immediate vicinity were qualitatively evaluated for instream and streamside habitat conditions. Each assessment team recorded the location of each site, utilizing a GPS unit when possible, and recorded detailed travel directions so future researchers might return to the same site. The assessed stream section was sketched. The team recorded physical stream measurements, erosion potential, possible point and non-point sources of pollution, and any anthropogenic activities and disturbances. It also recorded observations about the substrate, water, and riparian zone.

An important part of each assessment was the completion of a two page Rapid Habitat Assessment form (from EPA's RBP manual by Barbour et. al. 1999), which produced a numerical score of the habitat conditions most likely to affect aquatic life. The information from this form provided insight into which macroinvertebrate taxa might be expected at the sample site. Information on physical impairments to the stream habitat encountered during the assessment was also provided on the form. The following 12 parameters were evaluated:

- Instream cover
- Substrate
- Embeddedness
- Velocity/Depth regimes
- Channel alteration
- Sediment deposition
- Riffle frequency
- Channel flow status
- Bank condition
- Bank vegetative protection
- Grazing
- Riparian vegetation zone width.

A Rapid Habitat Assessment data set is valuable because it provides a means of comparing sites to one another. Each parameter on the assessment form was given a score ranging from 0 to 20.

Table 2 describes the categories that are used to rate each parameter.

Table 2. Scoring for Rapid Habitat Assessment

Optimal (score 16-20)	Habitat quality meets natural expectations
Sub-optimal (score 11-15)	Habitat quality less than desirable but satisfies expectations in most areas
Marginal (score 6-10)	Habitat quaility has a moderate level of degradation; severe degradation at frequent intervals.
Poor (score 0-5)	Habitat is substantially altered; severe degradation

The 12 individual scores for each parameter were added together and this sum was the final habitat condition score for each assessment site (maximum possible = 200). The habitat condition score and WVSCI score for each site were plotted on an X,Y graph (see Figures 9a-9c). Generally speaking, sites with points located in the upper right quadrant of the X,Y graph are those with suitable habitat and water quality to support a diverse benthic macroinvertebrate community. Those in the lower left usually have less suitable habitats that contribute to poor benthic communities. Points located in the upper left quadrant may represent sites that support relatively diverse benthic communities even though habitats are not the best. These sites often have good water quality. Sites with points in the lower right quadrant often are those with biological impairment due to something other than poor habitat (e.g., water pollution).

Assessment Results

General Overview

Section field teams visited 132 sites on 124 streams in the Tygart Valley River watershed in August and September of 1997 (see Figure 7). The larger streams were sampled at multiple locations. Two sites were sampled in duplicate as per the Section's Quality Assurance Plan.

Table 3. Sampling Summary

Named streams	416
Streams visited	124
Sites visited	132
Total sample sets	134
Habitat assessed	134
Water quality sampled	134
Benthic macroinvertebrates collected	129

Benthic Macroinvertebrates

There are five visited sites that were not sampled for benthic macroinvertebrates. Two were unwadeable and three were severely impacted by acid mine drainage (AMD). Fifteen of the benthic collections are considered non-comparable because of sampling methods. Eleven of the 15 were collected via the MACS (Mid-Atlantic Coastal Streams) method, three sites were sampled incompletely, and one other sample is considered non-comparable because there was not enough flow to adequately collect it with a net.

Of the 114 comparable benthic macroinvertebrate samples collected, 32 had WVSCI scores below the impairment threshold of 60.6. Sixteen samples scored in the "gray zone" (60.6 - 68). In Appendix A, Table A-5 shows the benthic macroinvertebrate community metrics and the WVSCI scores for all 129 benthic samples, both comparable and non-comparable. Table A-6, also in Appendix A, lists the taxa and counts for each of the sites.

Figure 8 shows the ranges within which each sub-watershed's average WVSCI score falls. Sample populations varied widely among the sub-watersheds, with Three Fork Creek sampled at just one site and Upper Buckhannon River sampled at 20 locations. The sub-watershed with the lowest average WVSCI score (31.37) was Finks Run, which was sampled at three sites. The Upper Mid-Tygart Valley sub-watershed had the highest average WVSCI score, 78.06.

Figures 9a and 9b show the relationship between the WVSCI score and the total score from the RBP habitat assessment. The data were divided in a manner to reduce crowding on the graphs and to allow the points to be labeled. In general, there is a positive correlation between habitat scores and WVSCI scores. Other assessments have shown that sites with high habitat scores, but low WVSCI

(Continued on page 34)

Figure 7. Sample Site Locations

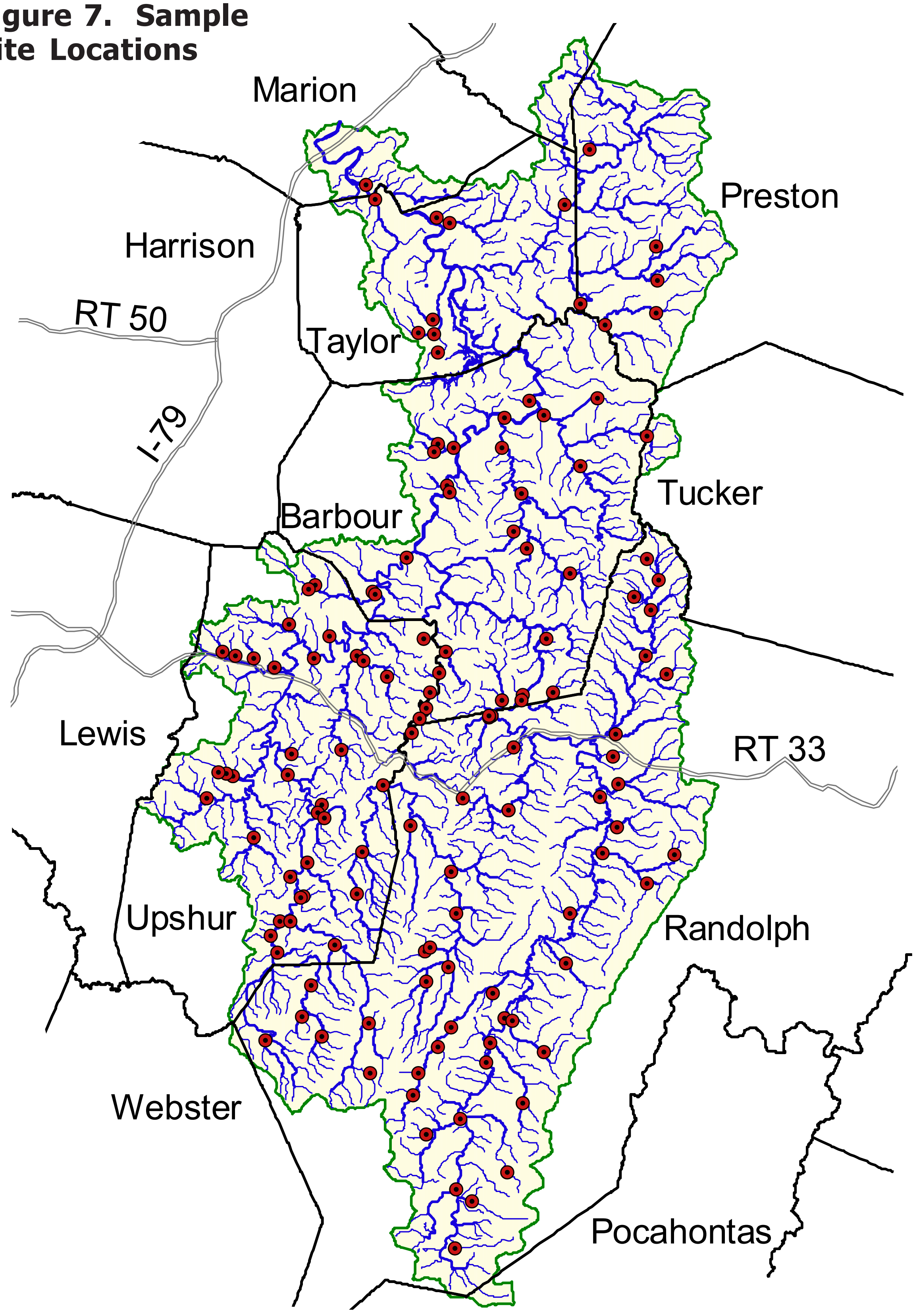


Figure 8. Average WVSCI score by 11-digit sub-watersheds

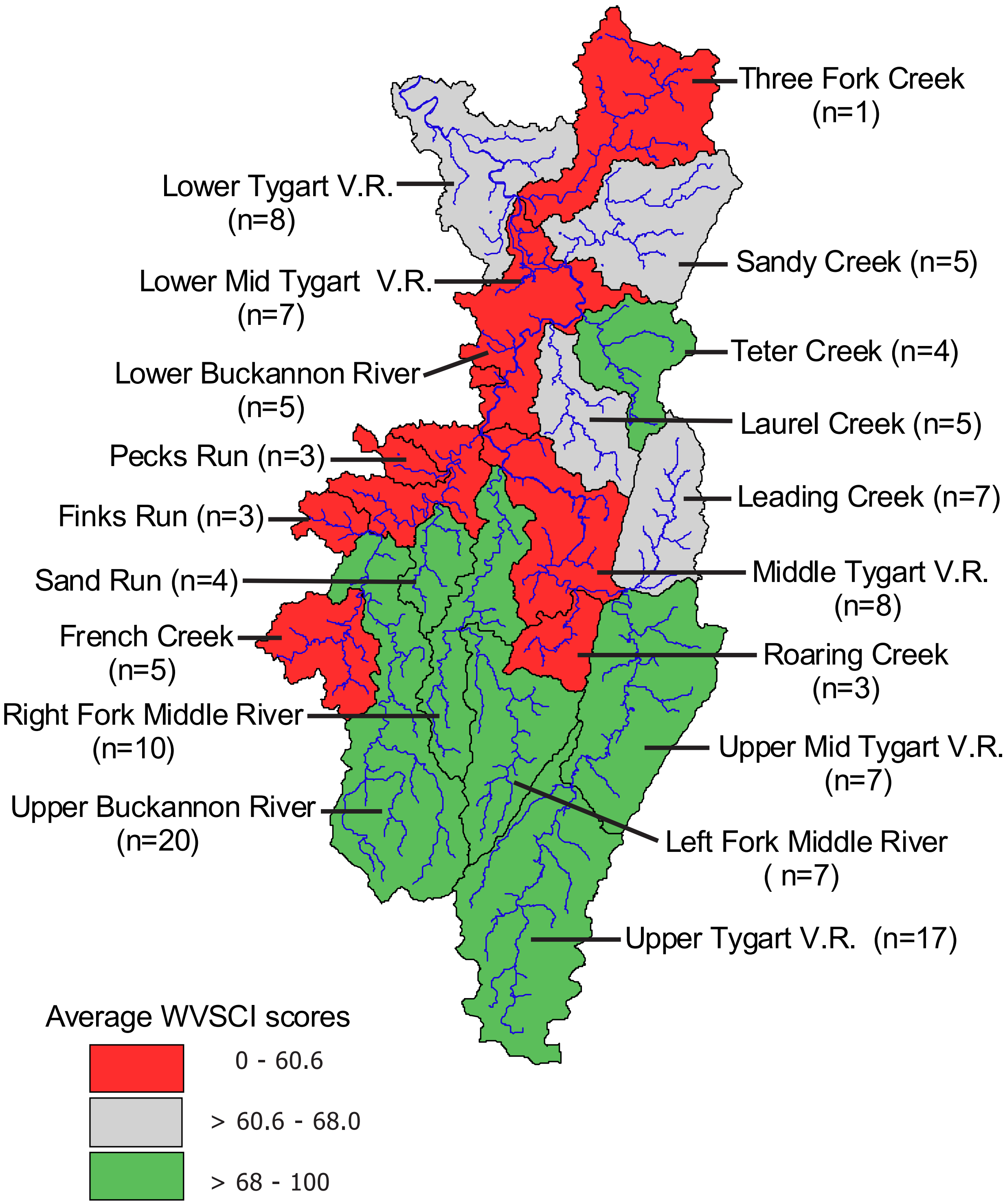


Figure 9a. Benthic health versus habitat condition. Sites from Buckhannon and Middle Fork River watersheds and surrounding areas.

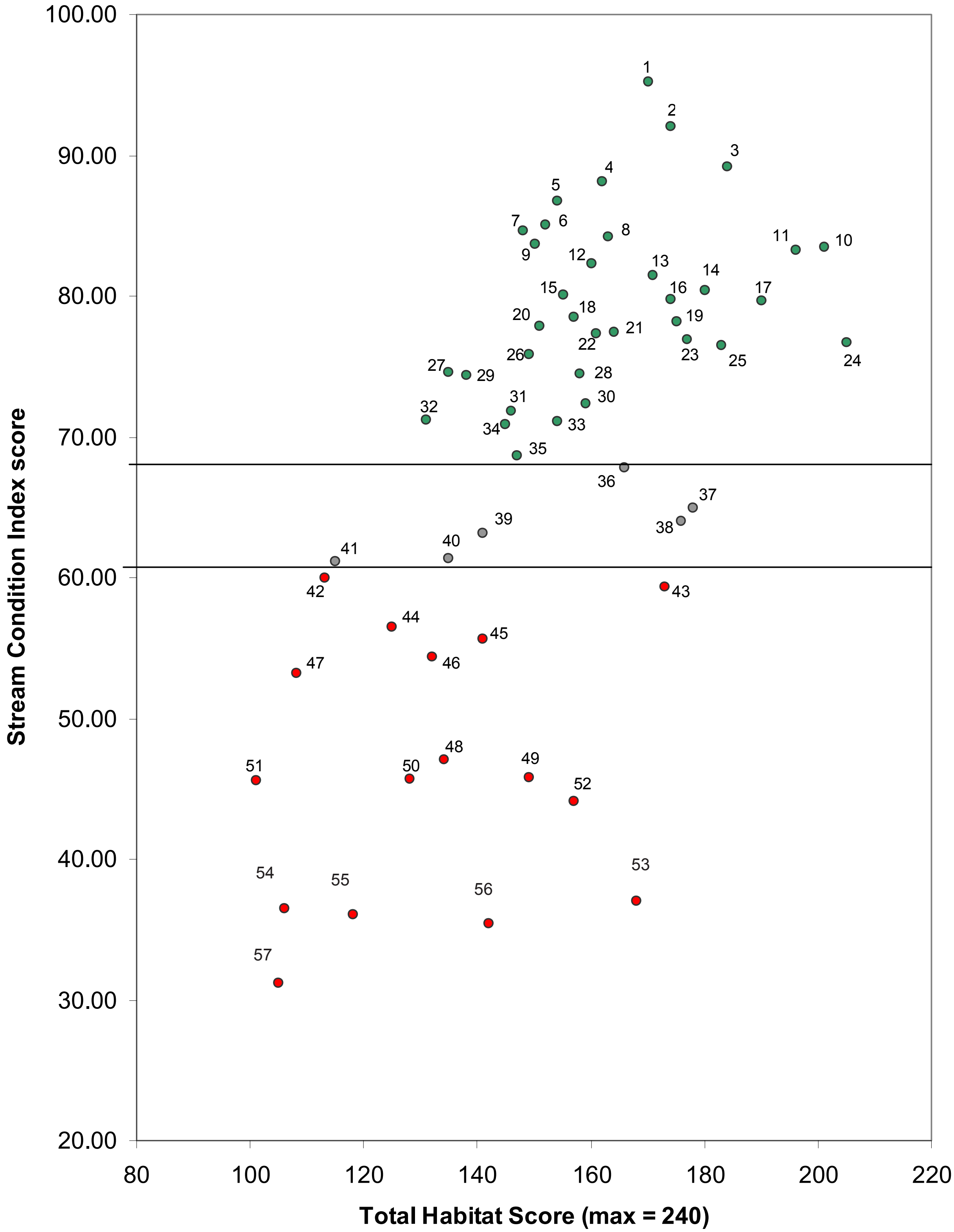


Table 4. Site information for Figure 9a

Figure #	Stream Code	Stream Name	WVSCI score	Total RBP habitat score
1	WVMT-75-{16.2}	STEWART RUN	95.26	170
2	WVMT-79-{0.9}	WINDY RUN	92.02	174
3	WVMT-64-C	GLADE RUN/MILL CREEK	89.16	184
4	WVMT-43-F-1	LOGLICK RUN	88.13	162
5	WVMT-74-B-1	FORTLICK RUN	86.77	154
6	WVMT-81-{0.8}	BIG RUN	85.12	152
7	WVMT-74	ELKWATER FORK	84.69	148
8	WVMT-50-A-1	LIMEKILN RUN	84.27	163
9	WVMT-43-M	CAMPFIELD RUN	83.67	150
10	WVMT-64-{6.7}	MILL CREEK	83.49	201
11	WVMT-50-B-3	HILL RUN	83.30	196
12	WVMT-50	FILES CREEK	82.35	160
13	WVMT-23-C-{5.6}	BRUSHY FORK	81.51	171
14	WVMT-23	TETER CREEK	80.45	180
15	WVMT-18-E-3-A-{1.2}	UNT/LEFT FORK/LITTLE SANDY CREEK	80.15	155
16	WVMT-68	BECKY CREEK	79.80	174
17	WVMT-64-E	MEATBOX RUN	79.69	190
18	WVMT-64-F	POTATOHOLE FORK	78.54	157
19	WVMT-57-{0.4}	JONES RUN	78.18	175
20	WVMT-22	CUNNINGHAM RUN	77.93	151
21	WVMT-68-D	WAMSLEY RUN	77.49	164
22	WVMT-61-{2.0}	SHAVERS RUN	77.31	161
23	WVMT-45	CHENOWETH CREEK	76.96	177
24	WVMT-5	LOST RUN	76.75	205
25	WVMT-24-{0.03}	LAUREL CREEK	76.49	183
26	WVMT-43-{15.6}	LEADING CREEK	75.83	149
27	WVM-27-{46.2}	TYGART VALLEY RIVER	74.59	135
28	WVMT-23-F	MILL RUN/TETER CREEK	74.54	158
29	WVMT-78	RALSTON RUN	74.36	138
30	WVM-27-{115.0}	TYGART VALLEY RIVER	72.43	159
31	WVMT-18-G-2	UNT/LEFT FORK/SANDY CREEK	71.81	146
32	WVMT-24-C	SUGAR CREEK	71.25	131
33	WVMT-18-E-4-A	TIBBS RUN	71.08	154
34	WVMT-64-A.5	BUCK RUN	70.88	145
35	WVMT-24-C-3.5	HUNTER FORK	68.63	147
36	WVMT-7	PLUM RUN	67.79	166
37	WVMT-43-{13.2}	LEADING CREEK	64.95	178
38	WVMT-48	KINGS RUN	64.03	176
39	WVMT-23-B-1	STONY RUN/RACOON CREEK/TETER CREEK	63.22	141
40	WVMT-11-{6.6}	BERKELY RUN	61.39	135
41	WVMT-24-C-2	BILLS CREEK	61.14	115
42	WVMT-11-A	SHELBY RUN	59.95	113
43	WVMT-8	WICKWIRE RUN	59.38	173
44	WVMT-43-O	LAUREL RUN	56.56	125
45	WVMT-66	RIFFLE CREEK	55.67	141
46	WVMT-26-{0.4}	HACKERS CREEK	54.41	132
47	WVMT-11-B	LONG RUN	53.18	108
48	WVMT-24-A	FROST RUN	47.04	134
49	WVMT-69	POUNDMILL RUN	45.80	149
50	WVMT-29	ANGLINS RUN	45.70	128
51	WVMT-43-A	CRAVEN RUN	45.58	101
52	WVMT-4	GOOSE CREEK	44.15	157
53	WVMT-12-{10.2}	THREE FORK CREEK	37.01	168
54	WVMT-43-H	DAVIS LICK	36.47	106
55	WVMT-18-{9.6}	SANDY CREEK	36.08	118
56	WVMT-42-B-1-{1.3}	UNT/FLATBUSH FORK	35.46	142
57	WVMT-66-B	MCGEE RUN	31.23	105

Figure 9b. Benthic health versus habitat condition. Other Tygart Valley River Sites (not in Buckhannon River or Middle Fork watersheds).

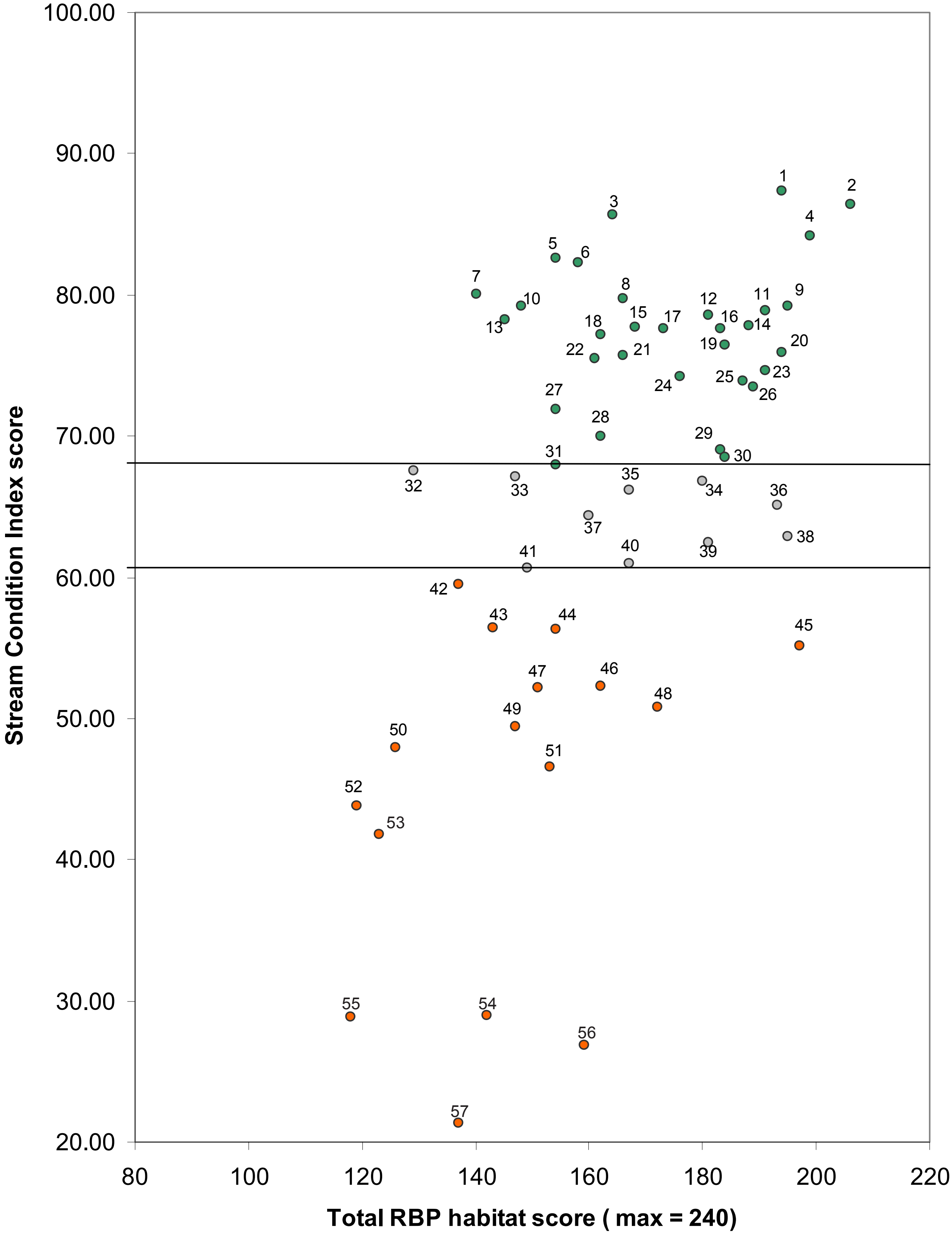


Table 5. Site information for Figure 9b

Figure #	Stream code	Stream Name	WVSCI score	Total RBP habitat score
1	WVMTM-25-A	BIRCH FORK	194	87.40
2	WVMTM-11-{7.6}	RIGHT FORK/MIDDLE FORK	206	86.42
3	WVMTM-2	LAUREL RUN	164	85.65
4	WVMTM-25-{1.5}	SCHOOLCRAFT RUN	199	84.19
5	WVMTB-7-{1.0}	SAND RUN	154	82.65
6	WVMTB-31-F-2-{0.8}	UPPER TROUT RUN	158	82.35
7	WVMTB-31-F-5	SALT BLOCK RUN	140	80.06
8	WVMTM-7	SHORT RUN	166	79.80
9	WVMTB-32-I-1	PHILLIPS CAMP RUN	195	79.20
10	WVMTB-7-C-{0.32}	UNT/SAND RUN	148	79.18
11	WVMTM-11-E	JENKS RUN	191	78.92
12	WVMTB-18-D-{3.9}	LAUREL FORK/FRENCH CREEK	181	78.62
13	WVMTM-13-{0.8}	LONG RUN	145	78.30
14	WVMTB-31-C	ALEC RUN	188	77.86
15	WVMTB-19-{0.9}	TRUBIE RUN	168	77.74
16	WVMTB-31-D	MILLSITE RUN	183	77.63
17	WVMTM-1	HANGING RUN	173	77.60
18	WVMTB-32-{0.4}	LEFT FORK/BUCKHANNON RIVER	162	77.20
19	WVMTB-32-{0.4}	LEFT FORK/BUCKHANNON RIVER	184	76.51
20	WVMTB-31-J	MARSH FORK	194	75.92
21	WVMTB-25-A	RIGHT FORK/TENMILE CREEK	166	75.69
22	WVMTM-5	SERVICE RUN	161	75.55
23	WVMTM-0.5-{0.6}	SWAMP RUN	191	74.68
24	WVMTM-11-{0.3}	RIGHT FORK/MIDDLE FORK	176	74.22
25	WVMTB-32-H	BEECH RUN	187	73.95
26	WVMTB-31	RIGHT FORK/BUCKHANNON RIVER	189	73.53
27	WVMTB-5	PECKS RUN	154	71.95
28	WVMTB-31-F-1	TROUT RUN	162	70.03
29	WVMT-40-{0.6}	BIG LAUREL RUN	183	69.11
30	WVMTB-30	HEROLDS RUN	184	68.57
31	WVMT-37-{2.8}	BEAVER CREEK	154	68.02
32	WVMTB-7-A-{2.9}	LAUREL FORK/SAND RUN	129	67.55
33	WVMTB-1	FIRST BIG RUN	147	67.11
34	WVMT-40-A	LITTLE LAUREL RUN	180	66.88
35	WVMTB-7-A-{0.5}	LAUREL FORK/SAND RUN	167	66.21
36	WVMT-33-{11.8}	MIDDLE FORK RIVER	193	65.10
37	WVMTB-28	BIG RUN	160	64.37
38	WVMT-40-{0.4}	BIG LAUREL RUN	195	62.94
39	WVMTB-32-D	BEAR CAMP RUN	181	62.52
40	WVMTM-21	PLEASANT RUN	167	60.99
41	WVMTB-8	BIG RUN	149	60.65
42	WVMTB-27	PANTHER FORK	137	59.51
43	WVMTB-18-B	BULL RUN	143	56.44
44	WVMTB-24	LAUREL RUN	154	56.35
45	WVMTM-26-B	ROCKY RUN	197	55.19
46	WVMTB-20	SAWMILL RUN	162	52.30
47	WVMTB-9	CHILDERS RUN	151	52.24
48	WVMT-36	ISLAND RUN	172	50.89
49	WVMTB-25	TENMILE CREEK	147	49.49
50	WVMTM-17	THREE FORKS RUN	126	48.02
51	WVMTM-3	HOOPPOLE RUN	153	46.56
52	WVMTB-11	FINKS RUN	119	43.85
53	WVMTB-18-B-3	MUDLICK RUN	123	41.84
54	WVMTB-10-A	SUGAR RUN	142	29.05
55	WVMTB-11-B.5	WASH RUN	118	28.85
56	WVMT-37-{0.0}	BEAVER CREEK	159	26.93
57	WVMTB-11-B	MUDLICK RUN	137	21.43

scores, frequently have observable water quality problems. Sites with low WVSCI scores and no obvious problems with habitat or water quality may be affected by episodic events, such as spills or discharges, that were not detected at the time of sampling.

The benthic communities of individual sites are discussed in the "Results by Sub-watershed" section of this chapter. All of the data referred to in the discussion (benthic metrics, physicochemical data, and habitat data) can be found in the tables in Appendix A.

There were 83 distinct family-level taxa identified from the 129 benthic samples. Figure 10 shows the macroinvertebrate taxa most frequently identified. Chironomids were most frequently encountered, being identified in 127 of the 129 samples (98.4%). Hydropsychidae, Tipulidae, Baetidae and Elmidae were the next most frequently identified families.

Fecal Coliform Bacteria

Approximately one third of the bacteria samples were in violation of the WV water quality criterion for primary contact recreation. This criterion states that fecal coliform bacteria concentrations are not to exceed 400/100 mL of sample in more than 10 % of the samples collected in a one month period. Since only one bacteria sample was collected per site per month during this study, each sample represents 100% of the samples collected in the month. Therefore, any concentration above 400/100 mL is a violation of the criterion. Ten sites had values greater than 2,000/100mL. Fecal coliform bacteria results are presented in Figure 11 and listed in Table A-7 of Appendix A. Further discussions on the bacteria violations of specific sites can be found in the "Results by Sub-watershed" section of this chapter.

Physicochemical Water Quality

Temperature, pH, conductivity, and dissolved oxygen were measured directly by field crews at all 132 sites visited. These field readings are summarized in Table A-7 of the Appendix. Streams varied in temperature from 11.8 to 28.9 °C. Seventeen of the sites had pH values below the state's lower water quality criterion of 6.0, but none were above the high criterion of 9.0. Four sites had DO concentrations below 5.0 mg/L and another six were below 6.0 mg/L. Conductivities ranged from 15 to 4,000 µmhos/cm.

In addition to these field readings, other water quality constituents were analyzed from samples collected at 91 of the sites. Samples from 37 randomly selected sites were analyzed for 22 parameters each. Samples from streams formerly listed as impaired by AMD were tested for acidity, alkalinity, and metals. From streams where nutrients were suspected to cause impairments, samples were collected accordingly. Results from these analyses are in tables 8a-c in Appendix A.

Figure 10. Frequency of occurrence of macrobenthic taxa. Taxa with greater than 15 occurrences are shown.

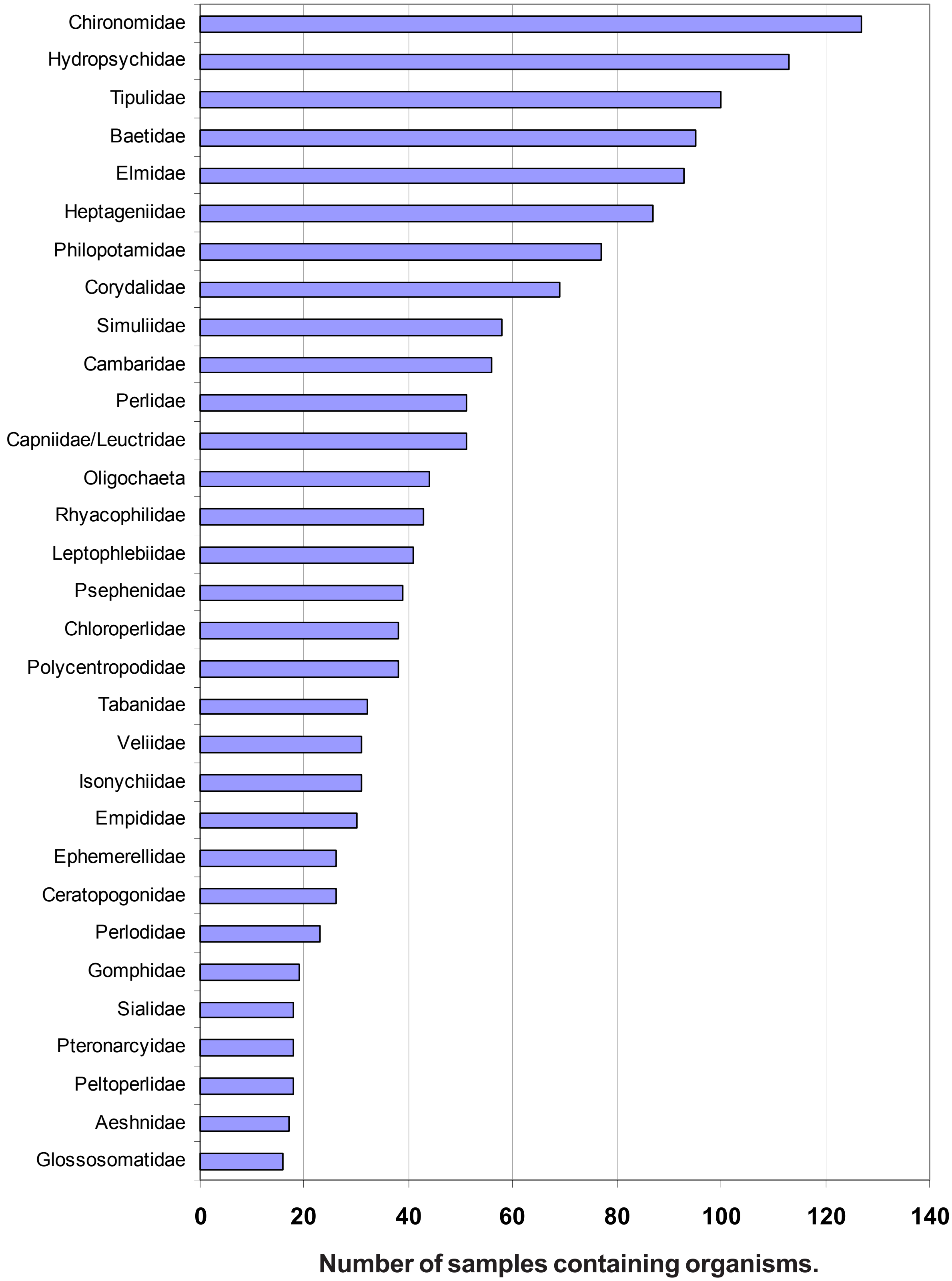
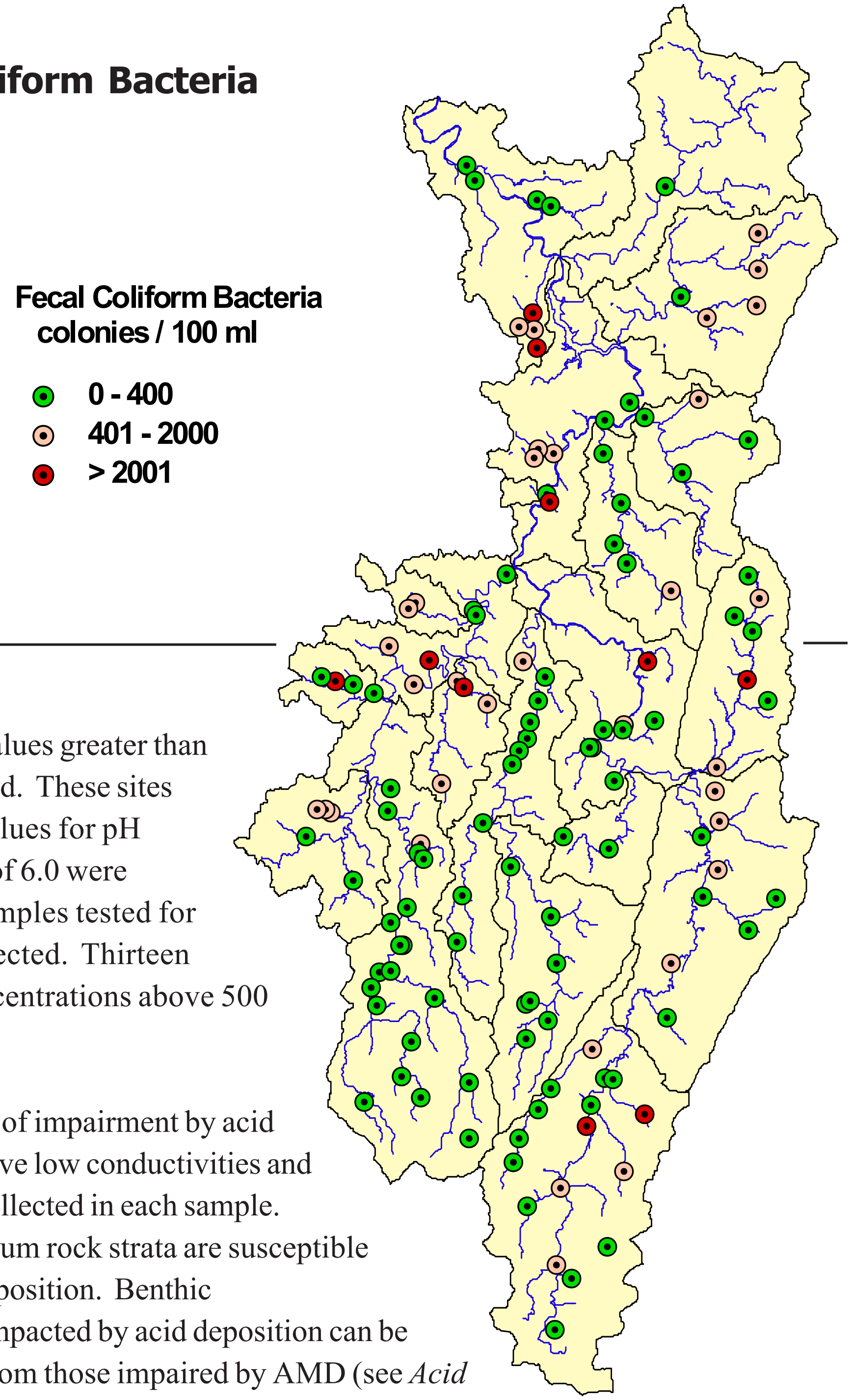


Figure 11. Fecal Coliform Bacteria



Seven sites had hot acidity values greater than 50 mg/L with no alkalinity detected. These sites also had pH values below 4.0. Values for pH below the water quality criterion of 6.0 were detected at 17 sites. Of the 70 samples tested for acidity, 54 (~ 77 %) had none detected. Thirteen samples (~ 19 %) had sulfate concentrations above 500 mg/L.

A few sites showed evidence of impairment by acid deposition. Such sites typically have low conductivities and low numbers of total organisms collected in each sample. Streams associated with low-calcium rock strata are susceptible to biological damage from acid deposition. Benthic macroinvertebrate communities impacted by acid deposition can be distinguished by the trained eye from those impaired by AMD (see *Acid Deposition vs. Acid Mine Drainage* box).

Water samples from 47 sites were analyzed for nutrients. The phosphorus concentration did not surpass 0.1 mg/L (the Program's flag value used in lieu of an official water quality criterion) at any site. Ammonia was relatively high (2.2 mg/L) at one site, the mainstem of Three Fork Creek (MT-12-{10.2}). Nitrate+nitrite nitrogen was over 1.0 mg/L (another flag value in lieu of a criterion) at Three Fork Creek and two other sites; Hackers Creek (MT-26-{0.4}) and Foxgrape Run (MT-26-B).

Acid Deposition vs. Acid Mine Drainage

Aquatic communities often respond differently to different pollutants. The various responses can be measured through a number of statistical tests and biometrics. In streams with unknown pollutants, these calculations can be used to decipher which potential pollutants are likely causes of impairment to the aquatic communities found therein. The WVSCI and its component metrics are useful tools for distinguishing between some forms of pollution.

In West Virginia, some streams are impacted by acid deposition, while others are impacted by acid mine drainage. Still others are impacted by both forms of acidic pollution. The responses of benthic macroinvertebrate communities to the two forms of acidic pollution are noticeably different in most cases.

Acid mine drainage often is a witch's brew of toxic pollutants. In many AMD waste streams, high concentrations of strong mineral acids (primarily sulfuric) strip hydroxide molecules from organic and inorganic substances alike. Most aquatic organisms cannot defend themselves against such powerful chemical onslaughts. Taxa diversities, numbers of individuals, and numbers of certain feeding groups, especially predators, decrease. Other components of the AMD witch's brew include high concentrations of various metal ions and sulfate. To add insult to injury, as the acidic waters become buffered downstream, metal hydroxides precipitate out of solution and form benthologically unfriendly sludges, covering benthic habitat.

In contrast, benthic substrates in acid deposition impacted streams are almost never compromised by the sky-borne pollution. Family-level taxa diversities remain relatively high in many acid deposition streams and all functional feeding groups are usually represented therein as well. Metal ions and sulfate are usually not greatly elevated above expected background concentrations, and conductivity measurements are most often below 70 μmhos/cm. The pH of acid deposition impacted streams can be quite low, sometimes below 3.5. The benthic macroinvertebrate communities in AMD impacted streams with similar pH values almost always compare very poorly to those in deposition impacted streams.

By utilizing the WVSCI and a few chemical data (i.e., pH and conductivity), WVDEP biologists can often readily distinguish between acid deposition impacted sites and AMD impacted sites.

Metals concentrations were elevated at relatively few sites. Eight of 84 samples (< 10 %) that were tested for aluminum had concentrations above the fisheries water quality criterion of 750 μg/L. Twelve sites produced manganese concentrations greater than the 1.0 mg/L human health criterion and 4 sites had iron above 1.5 mg/L (the criterion for both warmwater fisheries and human health uses).

Physical Habitat

Habitat in and around each stream was assessed at 134 sites. The physical properties of each 100 meter long sample site (average depths of riffle, run, and pool, and average stream width) were measured and recorded (Table A-2). Sites varied in average width from about 0.3 meters to 86 meters, with a mean of 5.16 meters. Almost 90 percent of the sampled reaches were less than 10 meters wide. Average riffle depths varied from one to twenty centimeters, with a mean of six centimeters.

Field crews looked for and noted the presence of activities and disturbances that could have an impact on each site's overall quality. Lawns were the most commonly observed disturbance (present at 46 sites), followed by power lines (41 sites), residences (36), residential roads (28), and pasture and hay fields (19). It should be noted that these results are biased to reflect more development because of the Section's site selection methodology. This methodology generally results in a site being located at the road crossing nearest each stream's mouth and these locations often have increased human developments.

The average scores for most RBP Habitat parameters were in the suboptimal range. The mean of one parameter, "riparian vegetation zone width – least buffered side" was in the marginal range. Results of the RBP Habitat Assessment can be found in Table A-9 in Appendix A. Fifty nine sites had optimal total habitat scores (≥160). Sixty two sites had totals in the suboptimal range (110-159.9) and the rest (8) had total habitat scores in the marginal range (60-109.9). None had an average score less than 60, so none was considered to have an overall poor habitat.

While all the parameters measure important aspects of stream habitat, some affect the benthic community more than others. "Embeddedness" is a measure of the amount of fine materials (silt & sand) surrounding the larger substrate types (cobbles & boulders). Embedding limits the interstitial space (areas between and below rocks) that benthic organisms depend on for shelter and other life-history requirements. Figure 12 illustrates stream substrate embeddedness.

Another important habitat parameter is "riparian vegetation zone width". The condition of the land next to a stream has a direct and important affect on the instream conditions. An intact riparian zone (i.e., one with a combination of mature trees, saplings, and ground cover) buffers the stream from pollutant runoff, controls erosion, and provides habitat and appropriate nutrient input into the stream (Figure 13).

Figure 12. Illustration of embeddedness

The view on the left is heavily embedded with sand and silt. Notice the different amounts of interstitial space (the space between the rocks and gravel).

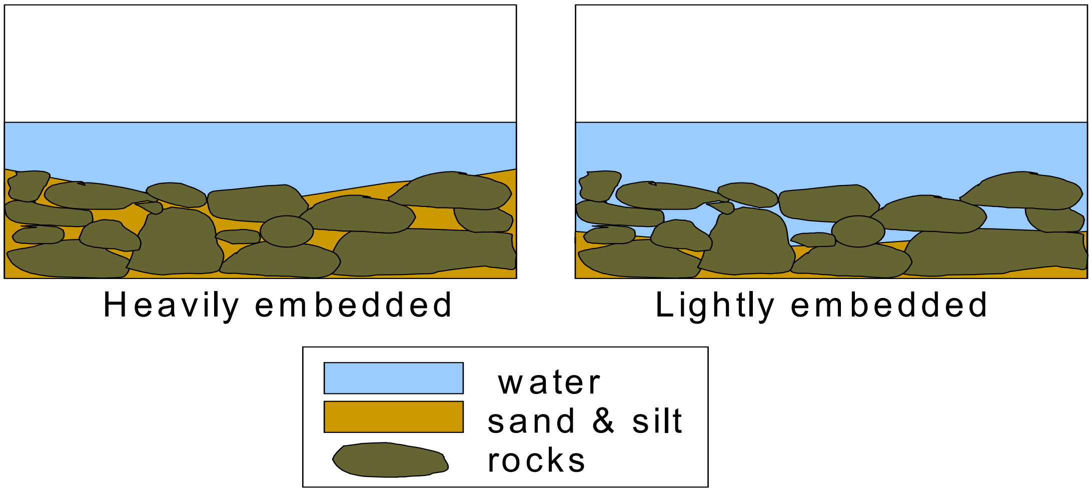
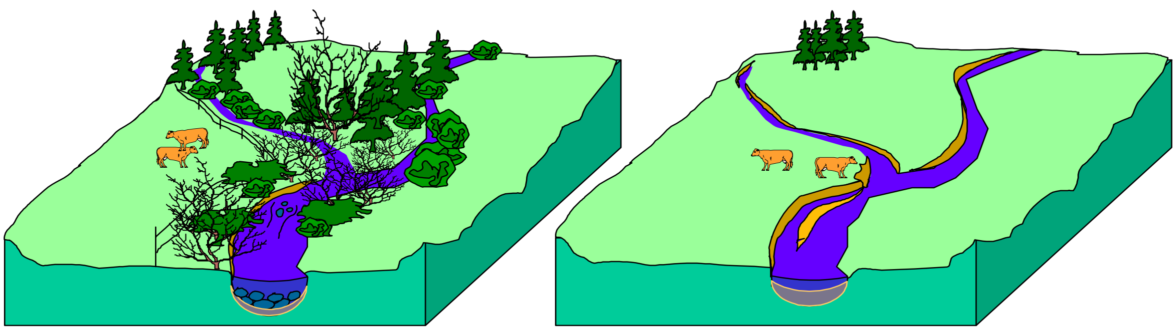


Figure 13. Stream with and without riparian buffer zone



Results by Sub-watershed

The scope of the Tygart Valley River watershed assessment was extensive. Not only was a large quantity of data collected, but the collection sites were spread throughout the watershed as well. This broad scope presented some difficulties in interpretation of the results. In order to facilitate and simplify discussion of the benthic data, the assessment sites were grouped by major sub-watershed (see Figure 8). Each sub-watershed section contains a simple map, a table of a few results, and a discussion of results. On the maps, some of the larger tributary streams are identified. In some of the tables, WVSCI scores of a few of the sample sites are reported as "N/C". This abbreviation means the results were not comparable for one reason or another, but primarily due to the use of sampling techniques not comparable to the RBP riffle/run sampling protocol. Each discussion focuses primarily on sites with impaired benthic macroinvertebrate communities. The discussions include information about landuse, water quality, and habitat. The Watershed Characterization and Modeling System (WCMS), which is an ArcView based GIS program developed by the Natural Resource Analysis Center of West Virginia University (www.nrac.wvu.edu), was used extensively to determine landuse, watershed size, and the locations of mining and other disturbances. However, because the WCMS database does not contain the most recent information available on landuse, it was utilized primarily to complement information provided by assessment teams and topographic maps.

Upper Tygart Valley River Sub-watershed

The Upper Tygart Valley River sub-watershed extends from Mill Creek (WVMT-64) to the headwaters of the river on the west slope of Back Allegheny Mountain . This stretch of the river flows generally northward. Tygart Valley River's headwater is characterized by swift current over a fairly steep gradient in a narrow valley. However, below the mouth of Elkwater Fork it becomes a slowly meandering river in a relatively broad valley that extends as far downstream as Leading Creek. In addition to Mill Creek, the following streams are significant tributaries of this sub-watershed: Riffle Creek, Becky Creek, and Elkwater Fork.

Nearly 90 % of this sub-watershed was forested. Land use activities included agriculture (~11 %), urban/residential (<1 %), coal mining (< 5%), and logging (unknown percentage). The human residential population was about 3,400.

Three streams assessed in this sub-watershed were identified on the 1998 303(d) list as impaired by acid rain: Glade Run, Meatbox Run, and Potatohole Fork. Standing alone, the data collected by the Section's sampling teams during this assessment do not support the listing of Glade Run. The primary criterion used to place streams on the 303(d) list for acid rain impairment was chronic low pH. If monitoring data indicated that long-term pH on any stream was less than 6.0, the stream was placed on the list. If long-term data were not available, professional judgement was used to list the stream

pH and Acid Rain

A pH measurement determines the hydrogen ion concentration of a substance. The pH also reflects how acidic or basic a substance is. The pH scale ranges from 0 to 14, with 7 being neutral. The pH of a substance generally decreases as it becomes more acidic. Pure water exhibits a neutral pH. Vinegar is an acidic substance (pH less than 7), while ammonia is a basic substance (pH greater than 7). Some aquatic species, such as brook trout and smallmouth bass, are generally unable to survive in streams with pH less than 5.0. Many kinds of benthic macroinvertebrates, especially mayflies, are intolerant of high acidity and low pH (Resh and Rosenberg 1984). The Environmental Quality Board of West Virginia established a minimum pH criterion of 6.0 for streams in the state.

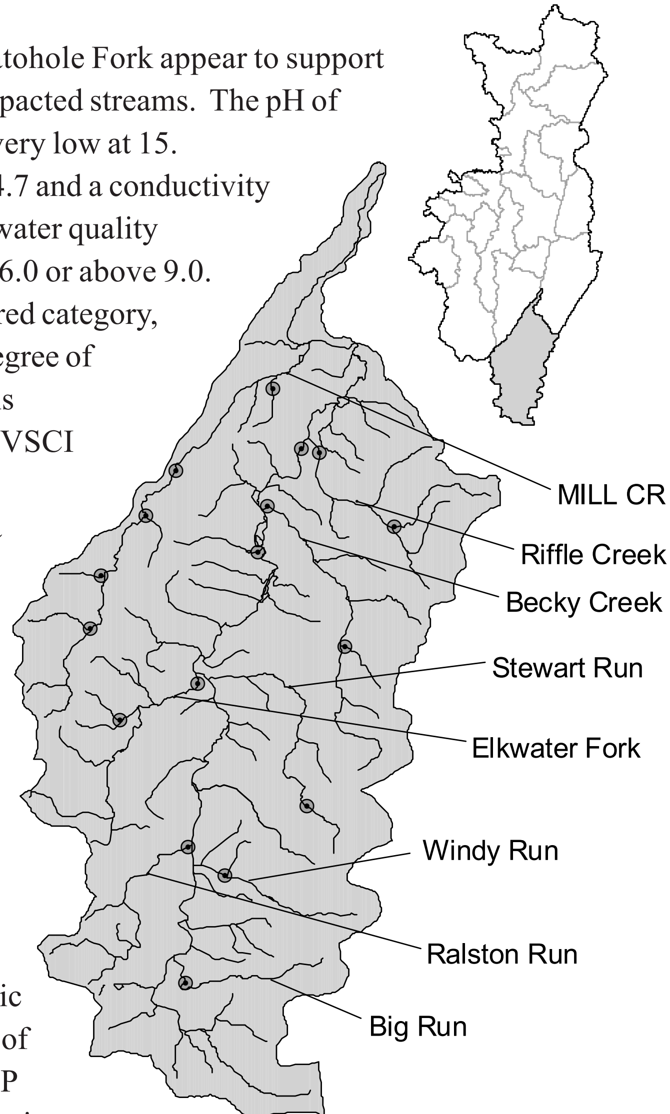
Acid deposition (commonly known as acid rain) is caused by the emissions of sulfur dioxide and nitrogen oxides that arise primarily from the burning of fossil fuels (e.g., coal and oil in power plants and gasoline in automobiles). Once released into the atmosphere, these oxides are converted into sulfuric acid and nitric acid, both of which dissolve readily in water and then lower its pH. The effects of acid deposition are seen primarily in streams with low buffering capacities (low alkalinity), that is, those streams surrounded by geologic materials (bedrock, soils, etc.) with limited abilities to neutralize acids. Generally, streams with low conductivity (< 50 µmhos/cm) also have low alkalinity or “buffering capacity”, which makes them likely candidates for acidification.

Acidification of streams may be continuous or only occasional, depending on the buffering capacity of the streams. Occasional acidification of streams typically occurs as a result of individual precipitation events (i.e., rainfall or snowmelt) and may last only for a few hours. If pH measurements are not recorded during these episodic events, the impacts of acidification may not be detected by chemical analyses. This illustrates the importance of including benthic macroinvertebrate sampling in assessment programs. Such organisms inhabit streams for considerable periods of time (months or years) and therefore indicate long-term water quality conditions. When compared to non-acidic streams, acidic waters generally have fewer taxa, lower abundances of individuals, and reduced biomass of benthic macroinvertebrates (Resh and Rosenberg, 1984).

Streams in some portions of the watershed are more sensitive to acid deposition than others. However, treatment technologies exist for such streams. Generally, a limestone-based material (e.g., limestone sand or gravel) is used to increase pH and alkalinity in streams impacted by acid deposition. The material can be placed directly on the stream substrates or mixed with water and discharged into the streams.

after careful consideration of water quality, resident biota, and general knowledge of the stream (see *pH and Acid Rain* box) . The assessment teams recorded single measurements for pH and conductivity during the assessment of Glade Run. The pH was sightly below neutral at 6.7, and the conductivity was relatively low at 24 µmhos/cm. Although these physicochemical measurements suggest that the run was vulnerable to negative impacts from acid rain, the benthic macroinvertebrate data suggest that any such impacts were not long-term. Glade Run data revealed a relatively high diversity (total taxa = 19) of benthic macroinvertebrates, with many of them being mayflies, stoneflies, and caddisflies (EPT Index = 12, see note on page 20). These indices resulted in a WVSCI score of 89.2, which is considered unimpaired.

Assessment data for Meatbox Run and Potatohole Fork appear to support their placement on the 303(d) list for acid rain impacted streams. The pH of Meatbox Run was 4.6 and the conductivity was very low at 15. Potatohole Fork had similar results with a pH of 4.7 and a conductivity of 15. Both pH values are violations of the state water quality criterion, which dictates no values can be below 6.0 or above 9.0. Although the WVSCI scores were in the unimpaired category, benthic macroinvertebrate data suggest a slight degree of negative impact by acid rain at these two sites. As compared to Glade Run, these sites had lower WVSCI scores (Meatbox Run = 79.7, Potatohole Fork = 78.5) and both had six fewer total taxa (total taxa = 13) and three fewer EPT taxa (9). However, these scores are considered quite good. Habitat did not appear to be a limiting factor at either site since total RBP scores were in the optimal (Meatbox Run = 190) and suboptimal (Potatohole Fork = 157) categories.



The Section's sampling teams assessed 17 sites in the Upper Tygart sub-watershed including one site on the mainstem. Fourteen sites had WVSCI scores above 68.0, indicating their benthic communities were unimpaired. Mill Creek is one of the unimpaired sites and is included in the WVDEP statewide reference site database. There were no sites with WVSCI scores in the gray zone. Two sites had scores below 60.6 and were rated as impaired. One of these sites, Riffle Creek approximately 0.4 miles upstream from its mouth, joins the Tygart Valley River near Huttonsville State Prison. The WVSCI score was 55.7. Assessment data provided several indicators of impairment including the following: heavy algal growth throughout the site, sludge deposits, a relatively high water temperature (28.6 C^{o}), and low dissolved oxygen (5.9 mg/L). The assessment team noted the presence of a pasture with livestock access to the stream. Additionally, lawns and ripraps for bank stabilization were present on both sides of the stream. Although the overall RBP habitat score (141) was in the suboptimal category, several parameters were rated "poor" including "channel alteration" (5), "bank vegetative protection (3), "riparian vegetation zone width" (0). Land use information obtained from the WCMS indicated that cropland and pastures were common upstream of the assessment area in the Riffle Creek drainage.

The data collected at Riffle Creek suggest that organic enrichment may have been impacting the benthic community. Organic enrichment, refers to higher than normal inputs of nutrients (such as nitrogen and phosphorus) to a stream or lake. Common sources of excessive nutrients in streams are fertilizers, animal wastes, and untreated domestic sewage. Organic enrichment can lead to eutrophication, a condition wherein a water body is characterized by excessive algal growth and low dissolved oxygen during certain hours of the day. As noted above, these characteristics were found at the Riffle Creek site. An examination of the benthic macroinvertebrate data also suggests that organic enrichment might have been impacting the site. Although the total number of taxa at this site was 16, nearly 77% of the sample was comprised of only two family-level taxa, *Chironomidae* (midges) and *Hydropsychidae* (a family of caddisflies). These organisms are generally considered tolerant of excessive nutrient concentrations and often respond to elevated nutrients by becoming dominant in the community. Additionally, the HBI score was 5.44. This index was developed specifically to detect organic enrichment in benthic communities, and a score of 5.44 indicates that such enrichment was likely at Riffle Creek.

Table 6. Upper Tygart Valley River sub-watershed sites

Stream Name	Stream Code	WVSCI	RBP	Fecal
TYGART VALLEY R	WVM-27-{115.0}	72.4	159	245
MILL CREEK	WVMT-64-{6.7}	83.4	201	0
BUCK RUN	WVMT-64-A.5	70.9	145	841
GLADE RN /MILL CK	WVMT-64-C	89.2	184	33
MEATBOX RUN	WVMT-64-E	79.7	190	155
POTATOHOLE FK	WVMT-64-F	78.5	157	39
RIFFLE CREEK	WVMT-66	55.7	141	80
MCGEE RUN	WVMT-66-B	31.2	105	2540
BECKY CREEK	WVMT-68	79.8	174	1
WAMSLEY RUN	WVMT-68-D	77.5	164	1009
POUNDMILL RUN	WVMT-69	45.8	149	5655
ELKWATER FORK	WVMT-74	84.7	148	568
FORTLICK RUN	WVMT-74-B-1	86.8	154	33
STEWART RUN	WVMT-75-{16.2}	95.3	170	0
RALSTON RUN	WVMT-78	74.4	138	1170
WINDY RUN	WVMT-79-{0.9}	92.1	174	37
BIG RUN	WVMT-81-{0.8}	85.1	151	4

Sites in gray blocks have WVSCI's indicating impairment.

A single grab-sample of water was collected at the Riffle Creek site and analyzed for total phosphorus (not detected) and nitrate+nitrite nitrogen (0.31 mg/L). The results do not indicate that there were high levels of either nutrient in the stream. These results suggest that the potential nutrient problem observed at this site may have been the result of a non-point pollution source (e.g., fertilizer or livestock wastes) that regularly entered the stream via runoff during precipitation events. The team's single grab-sample did not target one of these events.

A team sampled a site on McGee Run and found it to be biologically impaired with a WVSCI score of 31.2. McGee Run is a small tributary of Riffle Creek that drains the western slope of Cheat Mountain. The sample site was near the run's mouth, approximately 3.2 miles up Riffle Creek from the confluence of Riffle Creek and Tygart Valley River. The assessment provided information on numerous activities and disturbances, including heavy local watershed erosion, severe dredging of the stream channel and poorly vegetated stream banks. There was a high abundance of periphyton and algae. The overall RBP habitat assessment scored in the marginal category (105). All the natural vegetation had been removed from the riparian zone on both sides of the stream and the bank condition was rated as poor with many eroded areas present throughout the examined reach. “Channel alteration” and "sediment deposition" received scores in the low end of the marginal category.

At 2,540/100mL, the bacteria concentration in McGee Run was substantially higher than allowed by the water quality standards. The source of bacterial contamination at this site was not determined.

Nutrient samples were not collected from McGee Run, but an abundance of algae and periphyton suggests the site may have been nutrient enriched. The benthic macroinvertebrate data also suggest nutrient enrichment. Only seven family-level taxa were represented in the sample. Also, the sample was dominated by chironomids (77.9%) and the HBI score was 5.60. Both of these characteristics indicate the presence of organic enrichment. The poor habitat parameters observed, particularly extensive channelization and heavy sediment deposition, likely contributed to this site’s biological impairment as well.

The Poundmill Run site was found to be impaired with a WVSCI score of 45.8. Poundmill Run is a direct tributary of Tygart Valley River and is located about 4.3 miles upstream of the town of Huttonsville. The majority of this stream’s drainage area was forested. Assessment data indicated the presence of mowed lawn on both sides of the stream, pipes and drains, powerlines, and a permitted waste water treatment outfall from Bishop Hodges Pastoral Center (NPDES # WV0085618). The stream is impounded about 0.2 miles upstream of the assessment site. Periphyton and algae were moderately abundant. The RBP habitat assessment total score of 149 is in the suboptimal category. Two parameters were given a poor rating “grazing or other disruptive pressure” and “riparian vegetation zone width”.

Field readings of water quality failed to provide clues on the observed biological impairment. However, the fecal coliform bacteria sample proved to be in violation of the state water quality criterion with a concentration of 5,655/100 mL. Improper treatment of sewage from the Bishop Hodges Pastoral Center outfall may have contributed to the bacteria violation, but this seems unlikely since there were no sediment or water odors and no indication of a solids-laden plume from the discharge. However, nutrient enrichment is often associated with the improper treatment of sewage, and the benthic macroinvertebrate data are indicative of nutrient enrichment with the sample dominated by chironomids (66.7%) and an HBI score of 5.4.

The Tygart Valley River site received a WVSCI score (72.4) indicating it was unimpaired. This site is located behind the Huttonsville State Prison. A cornfield was located on one bank. Algae and periphyton were rated as moderately abundant and an anaerobic odor was detected in sediment deposits within the stream. The RBP habitat assessment resulted in a suboptimal score of 159.

"Sediment deposition" was given a marginal score of 6, and "riparian vegetation zone width" was given a poor score of 1. Physicochemical field readings provided no evidence of water quality impairment at the Tygart Valley River site. In addition, the water sample laboratory analyses revealed no impairment. The concentration of fecal coliform bacteria (245/100mL) did not violate the state criterion.

Six of the 17 sites sampled for fecal coliform bacteria showed concentrations exceeding the state's water quality criterion. Four of these six sites had WVSCI scores indicating they were not impaired. Wamsley Run had a bacteria concentration of 1,009/100mL. The assessment team made note of a nearby house, but made no specific reference to any possibility of fecal contamination from the house. A similar notation was recorded for Buck Run, which had 841/100mL. The WCMS indicated the presence of agricultural activities in the vicinity of the Buck Run sampling site, but none in the Wamsley Run sub-watershed.

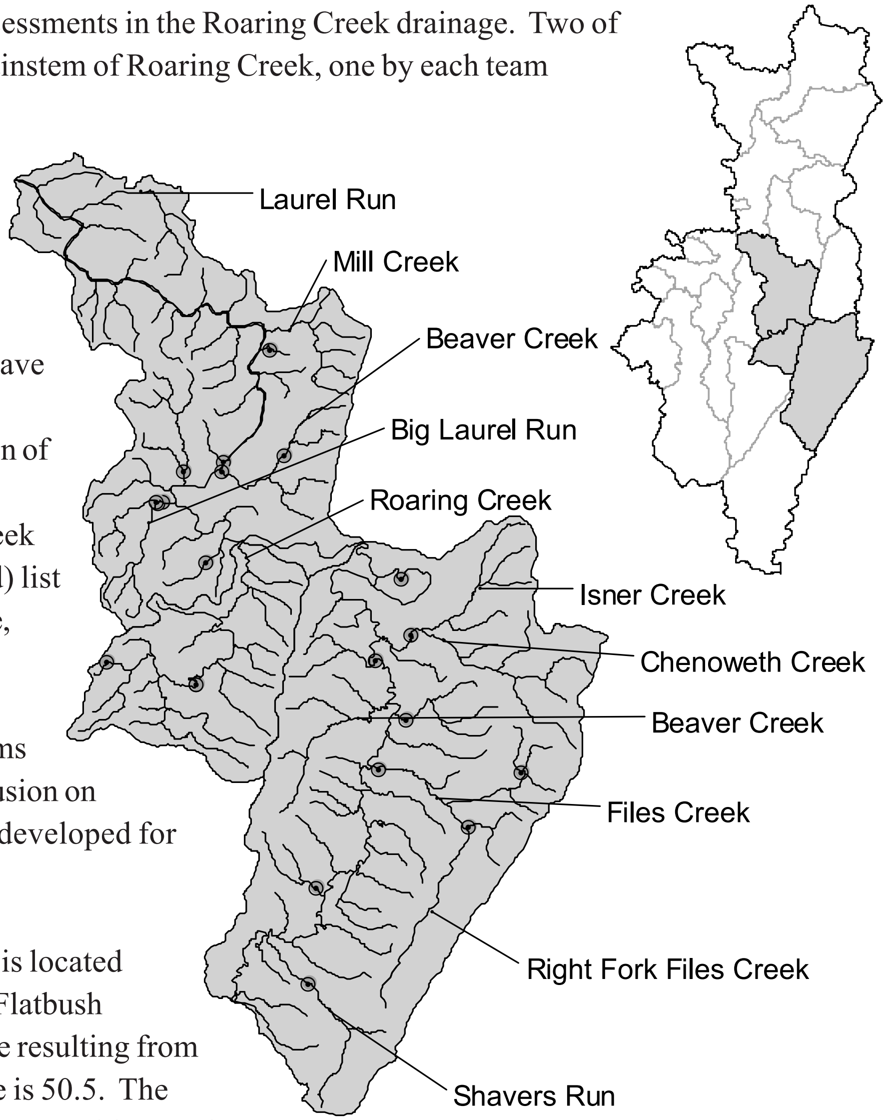
The Elkwater Fork site, which had a bacteria concentration of 568/100mL, was located near a pasture. However, most of the sub-watershed was forested. Ralston Run had a number of residences alongside it in the lower portion of its mainstem valley, as well as some pasturage in its headwater area. Other potential sources of the bacteria contamination found at the sampling site (1,170/100mL) include a small dog lot and garbage stacked on one streambank, both of which were noted by the assessment team.

Upper Mid Tygart Valley River Sub-watershed

The Upper Middle Tygart Valley River sub-watershed extends from Mill Creek downstream to the confluence of the Buckhannon River, exclusive of that river. This section of the Tygart Valley River flows generally northward through Randolph County and then meanders gradually to the northwest into Barbour County as it approaches the mouth of the Buckhannon River. The drainage area is approximately 241 square miles. Important tributaries of this sub-watershed include Files Creek , Chenoweth Creek, Roaring Creek, Beaver Creek, and Mill Creek (WVMT-35). Several towns are located in this watershed including Valley Bend, Daily, Beverly, Elkins, and Belington. Nearly 77.0% of this sub-watershed is forested. Land use activities include agriculture (17.0%), urban/residential (<3.0%), coal mining (<4.0%), and logging (unknown percentage). The population is about 19,500.

The teams assessed twenty sites in the Upper Middle Tygart sub-watershed. The Roaring Creek site was sampled twice for quality control purposes. Eighteen sites were sampled for benthic macroinvertebrates, four of which were considered non-comparable due to differences in sampling methods (3 MACS samples and 1 handpicked sample). Although the four sites were considered non-comparable, WVSCI scores were calculated in order to provide baseline data for the impairment determination process.

Teams conducted three assessments in the Roaring Creek drainage. Two of these were duplicates on the mainstem of Roaring Creek, one by each team member. The other assessment was on an unnamed tributary of Flatbush Fork, a headwater of Roaring Creek.



Several large areas of the Roaring Creek sub-watershed have been mined for coal. This has resulted in significant degradation of the water quality of many of the creek's tributaries. Roaring Creek was included on the 1998 303(d) list for impairment by mine drainage, with pH and metals listed as the causes of impairment. The data collected by the assessment teams supported Roaring Creek's inclusion on the list. In 2001, a TMDL was developed for Roaring Creek.

The site on Roaring Creek is located about 1.4 miles downstream of Flatbush Fork. The highest WVSCI score resulting from the duplicate samples at this site is 50.5. The samples are considered non-comparable to other benthic samples because there was no riffle/run habitat from which a standard kick net sample could be collected. The team used the MACS technique to sample woody snags lying in the stream. The assessment team noted the stream was heavily embedded with sand and silt. Two benthic samples collected at this site contained similar benthos, and neither contained a mayfly or stonefly representative.

Mining related activities appeared to be the causes of impairment. The pH was low (4.5) and the stream had very little acid neutralizing capacity, with the alkalinity at 3.0 mg/L. Values for sulfate and some metals also indicated the presence of mine drainage (sulfate = 210 mg/L, aluminum = 1.8 mg/L, & manganese = 2.5 mg/L). Even though treatment technologies have been employed upstream of the Roaring Creek assessment site (in the Flatbush Fork drainage) to reduce metals concentrations, these concentrations at the Roaring Creek site are still in violation of state water quality standards.

Table 7. Upper Mid Tygart Valley River sub-watershed sites				
Stream Name	ANCODE	WVSCI	RBP	Fecal
TYGART VALLEY R	WVM-27-{83.0}	N/C	151	1269
TYGART VALLEY R	WVM-27-{93.6}	N/C	121	275
SHOOKS RUN	WVMT-35.5	N/C	116	3200
ISLAND RUN	WVMT-36	50.89	172	680
BEAVER CREEK	WVMT-37-{0.0}	26.93	159	0
BEAVER CREEK	WVMT-37-{2.8}	68.02	154	0
BACK FORK	WVMT-38-A	N/C	160	320
BIG LAUREL RUN	WVMT-40-{0.4}	62.94	195	9
BIG LAUREL RUN	WVMT-40-{0.6}	69.11	183	9
LITTLE LAUREL RN	WVMT-40-A	66.88	180	13
GRASSY RUN	WVMT-41-{1.0}	N/C	116	2
ROARING CREEK	WVMT-42-{7.7}	N/C	108	6
ROARING CREEK	WVMT-42-{7.7}	N/C	119	16
UNT/FLATBUSH FK	WVMT-42-B-1-{1.3}	35.46	142	0
CHENOWETH CK	WVMT-45	76.96	177	920
KINGS RUN	WVMT-48	64.03	176	1076
FILES CREEK	WVMT-50	82.35	160	377
LIMEKILN RUN	WVMT-50-A-1	84.27	163	48
HILL RUN	WVMT-50-B-3	83.30	196	160
JONES RUN	WVMT-57-{0.4}	78.18	175	472
SHAVERS RUN	WVMT-61-{2.0}	77.31	161	275
Sites in gray blocks have WVSCI's indicating impairment. N/C = non-comparable.				

Anhydrous ammonia and sodium hydroxide have been used to treat mine drainage at a reclaimed Bentley Coal Company mine in the Flatbush Fork sub-watershed. Mining appeared to be the cause of impairment at the unnamed tributary of Flatbush Fork site. This site is located about 0.8 miles upstream of its confluence with Flatbush Fork. The WCMS indicated the presence of abandoned mine lands in the extreme headwaters of this small tributary. The comparable benthic macroinvertebrate sample from this site received a WVSCI score of 35.46, indicating that it was impaired.

Water quality analyses indicated severe impairment (pH = 3.3, conductivity = 810 µmhos/cm, hot acidity = 170 mg/L, alkalinity = 0.0 mg/L, sulfate = 350.0 mg/L). The site was heavily embedded with sand and silt.

The benthic macroinvertebrate data suggested mine drainage impacts. The total taxa score (6) and the EPT Index (3) are considered quite low. There were no mayflies represented in the sample and the only stoneflies present were the *Capniidae*/*Leuctridae* family group, often found in mine drainage streams and often dominant in such streams.

Assessments were conducted at two locations on Beaver Creek. The site nearest the mouth (WVMT-37-{0.0}) was considered impaired, with a WVSCI score of 26.93. Beaver Creek is included on the 1998 303(d) list for impairment by mine drainage, with pH and metals listed as the pollutants. Assessment data substantiated mine drainage as the likely cause of impairment at the mouth of Beaver Creek (pH = 3.5, conductivity = 619 µmhos/cm, hot acidity = 65.0 mg/L, alkalinity = not detected, sulfate = 520.0 mg/L, aluminum = 8.2 mg/L, iron = 1.3 mg/L, & manganese = 1.5 mg/L). A reddish precipitate, known as iron hydroxide, covered the stream substrate. Benthic data revealed severe impairment to the macroinvertebrate community. There were only 61 individuals in the sample representing 6 taxa. Mayflies, stoneflies, and caddisflies were absent. Chironomids were the dominant taxon (61.0%) in the sample.

The water quality was slightly better in Beaver Creek approximately 2.8 miles upstream from the mouth (WVMT-37-{2.8}) (pH = 5.1, conductivity = 328 µmhos/cm, hot acidity = 7.0 mg/L, alkalinity = 3.0 mg/L, sulfate = 200.0 mg/L, aluminum = 0.44 mg/L, iron = 1.0 mg/L, manganese = 0.89 mg/L). Iron precipitate on the stream bottom was described as slight. The WVSCI score was higher at this site (68.02), placing the site at the high end of the gray zone. Both diversity and the EPT Index were higher (total taxa = 10 & EPT Index = 4), but still considered relatively low. Based on the data collected during the Section's assessment, it appears likely that the entire length of Beaver Creek has been impaired by mine drainage.

A site on Island Run was found to be impaired, with a WVSCI score of 50.89. The site is close to the mouth of Island Run near the village of Gage. Land use in this drainage includes strip mining, agriculture, and oil/gas extraction (WCMS). The RBP habitat assessment resulted in a high end suboptimal score of 172. Island Run is listed on the 1998 303(d) list for impairment by mine drainage, with pH and metals listed as the causes. The analysis of a water sample collected at the site indicated that sulfate (220.0 mg/L) in the stream was relatively high. However, additional mine drainage parameters showed less reason for alarm (pH = 6.84, hot acidity = not detected, alkalinity = 57.0 mg/L, aluminum = 0.250 mg/L, iron = 1.0 mg/L, & manganese = 0.850 mg/L). The concentration of fecal coliform bacteria (680/100mL) exceeded the state criterion.

Benthic macroinvertebrate data at the Island Run site were more indicative of mine drainage and/or nutrient enrichment than were the water sample analyses. Diversity was poor, with a total taxa score of 10. There were no mayflies or stoneflies in the sample. The EPT Index of 2 was represented by only caddisfly taxa (*Hydropsychidae* & *Polycentropodidae*). The two dominant taxa in the sample were *Hydropsychidae* and *Chironomidae* (midges). Collectively, these tolerant taxa comprised 71.0% of the sample. Abundance was also low, with only 38 individuals found in the entire sample.

Kings Run was sampled near its confluence with the Tygart Valley River at the community of Hazelwood. This site received a WVSCI score (64.03) in the gray zone, indicating that the single kick sample collected was not sufficient to determine the impairment status of the site. The benthic macroinvertebrate sample exhibited good diversity with a total taxa score of 16. However, other indices suggested the stream was impacted by nutrient enrichment. The EPT Index of 5 is considered rather low. There were no stonefly taxa found in the sample. The sample was dominated by two nutrient loving taxa, the caddisfly family *Hydropsychidae* and the midge family *Chironomidae* (Percent 2 Dominant Taxa =54.7%).

The WCMS indicated that agriculture was a predominant land use in the Kings Run drainage. Residential areas were also present. U.S. Route 250/219 crosses Kings Run at three points. Mining was absent from the sub-watershed. A parking lot that served Superior Laundries was located on the right bank and a power line crossed the stream at the upper end of the stream assessment site. There was a moderate abundance of periphyton/algae. The RBP habitat assessment resulted in a high, suboptimal score of 176. None of the parameters were rated "poor".

Water quality field measurements did not indicate impairment at the Kings Run site. No impairment was revealed in the water sample analyses either. However, the concentration of fecal coliform bacteria violated the state criterion with a value of 1,076/100mL. The sources of bacterial contamination may be livestock and/or poorly treated sewage, but there were no clear clues provided on the assessment form.

Two sites on Big Laurel Run were assessed (lower WVMT-40-{0.4} & upper WVMT-40-{0.6}). Big Laurel Run flows into Tygart Valley River about 0.4 miles south of the Barbour / Randolph County line. Land use in the sub-watershed included mining and oil/gas extraction (WCMS). These two sites were very similar with respect to most assessment data. Both sites were forested and RBP habitat assessments were optimal. Dry weather previous to the assessment resulted in low water conditions, therefore "channel flow status" was given a marginal score at both sites. Physicochemical field readings were also similar at both sites and did not produce values indicative of mine drainage: pH = 7.0 & conductivity = 112 µmhos/cm for WVMT-40-{0.4}, and pH = 7.1 & conductivity = 129 µmhos/cm for WVMT-40-{0.6}. The water sample collected at WVMT-40-{0.4} was analyzed for acidity (not detected), alkalinity (15.0 mg/L), sulfate (46.0 mg/L), aluminum (0.051 mg/L), iron (0.170 mg/L), and manganese (0.045 mg/L). None of the results indicated that mine drainage was a problem during the survey. The water quality sample collected from the upper site was analyzed for only bacteria and total suspended solids.

The WVSCI score at the lower Big Laurel Run site was 62.94. The upper site received a WVSCI score of 69.11. Therefore, the lower site benthic sample was considered to be in the gray zone, while the upper site's sample was considered unimpaired. Little Laurel Run, a major tributary that discharges into Big Laurel Run between the upper and lower sample sites, may have contributed to the difference in WVSCI scores between the two sites.

Although not included on the 1998 303(d) list of streams impaired by acid rain, Big Laurel Run might have been susceptible to acidification. Little Laurel Run is a significant tributary that was included on the list due to acid rain. Benthic macroinvertebrate data from both Big Laurel Run sites suggested the possibility of acid rain impairment. Benthic diversity was relatively low at both sites (total taxa = 12 at both sites). The EPT Index was also low at each site (WVMT-40-{0.4} = 5, WVMT-40-{0.6} = 6). Big Laurel Run might be susceptible to acidification only when flow increases as a result of snowmelt or rainfall. If assessments are not conducted during such episodic events, the impacts of acidification often are not detected in physicochemical measurements. In such cases, benthic macroinvertebrate data are usually more accurate assessment tools because they generally reflect past water quality conditions. If Little Laurel Run were truly impaired by acid precipitation (at least periodically), then the stream's water may have negatively impacted Big Laurel Run's benthic community at the lower sampling site. Further study of these two streams may lead to greater certainty about their biological conditions.

Little Laurel Run was assessed near its mouth and received a WVSCI score (66.88) in the gray zone as did the lower Big Laurel Run site. The WCMS indicated that agriculture and oil/gas activities were present in the Little Laurel Creek drainage. The only notable disturbance at this site was a limestone gravel road. The RBP habitat assessment total score was 180, placing it in the optimal range. Dry weather previous to the assessment resulted in low water conditions, therefore "channel flow status" was given a marginal score of 6.

Although Little Laurel Run was placed on the 303(d) list for impairment by acid rain, the pH field measurement of 7.4 did not indicate impairment by acidification. However, the conductivity (52 µmhos/cm) was relatively low, suggesting that the stream was probably low in alkalinity and, perhaps, susceptible to acidification. Benthic macroinvertebrate data suggested this site may have been impaired by acid precipitation or some other cause. The total taxa score (13) and EPT Index (7) were relatively low. Further sampling during acid precipitation runoff events could substantiate or refute Little Laurel Run's inclusion on the 303(d) acid rain impairment list.

Grassy Run was sampled alongside a recently reclaimed abandoned mining site. The water was very acidic (acidity = 180 mg/L), the pH was 3.07, and the metals concentrations were very high (dissolved Al = 14.246 mg/L, dissolved Fe = 15.680 mg/L, & manganese = 1.7260 mg/L). The field crew did not collect a full benthic sample, rather it performed a cursory kick sample to check for the presence of any aquatic organisms - none were found. There were houses along the sample reach with direct sewage discharges into the stream. The laboratory result for fecal coliform bacteria analysis was recorded as < 2/100mL. The minimum reporting limit is 2/100mL. In all likelihood, there were actually no bacteria in the sample. The low pH in Grassy Run would have killed any bacteria present in the sewage. Coal mining activities in this stream were the sources of the pollutants causing severe degradation therein.

The Section's sampling team assessed one site on Back Fork near its confluence with Zebs Creek. Zebs Creek flows into the Tygart Valley River on the north side of the Barbour County/ Randolph County line. Land use in the Back Fork drainage was primarily agriculture with some oil/gas extraction, according to the WCMS. The WVSCI score at this site was 59.99, which would have placed it near the gray zone had the benthic sample been collected in a comparable manner. However, the sample was considered non-comparable because the handpick method was used instead of the standard riffle/run kick method. The handpick method was used because the stream was nearly dry with no flowing water. Consequently, physicochemical field measurements and benthic samples were collected in disconnected pools of water throughout the 100 m assessment area. The low dissolved oxygen measurement (3.6 mg/L) at the site was likely due to the no flow condition of the standing pools. In order to obtain an accurate assessment of benthological health, a sampling team should revisit Back Fork when stream flow is more conducive to collecting a benthic macroinvertebrate sample.

Shooks Run is a small tributary of Tygart Valley River near the town of Belington. The stream was sampled behind the Belington Post Office. This site exhibited all of the disturbances normally associated with an urban setting: residences, lawns, pipes/drains, and numerous roads. Sand and silt deposits were described as heavy. The water was described as moderately turbid. The RBP habitat assessment resulted in a suboptimal total score of 116. The instream cover for fish was given a low marginal score (6) and benthic macroinvertebrate instream habitat was marginal (7). Vegetation along both riparian zones had been removed, resulting in no shade over the sampling site.

The concentration of fecal coliform bacteria (3,200/100mL) at Shooks Run exceeded the state water quality criterion. However, nutrient data from the site did not indicate excessive enrichment (total phosphorus = 0.04 mg/L, ammonia nitrogen = not detected, nitrate+nitrite nitrogen = 0.19 mg/L). The cause of high bacteria levels is unknown.

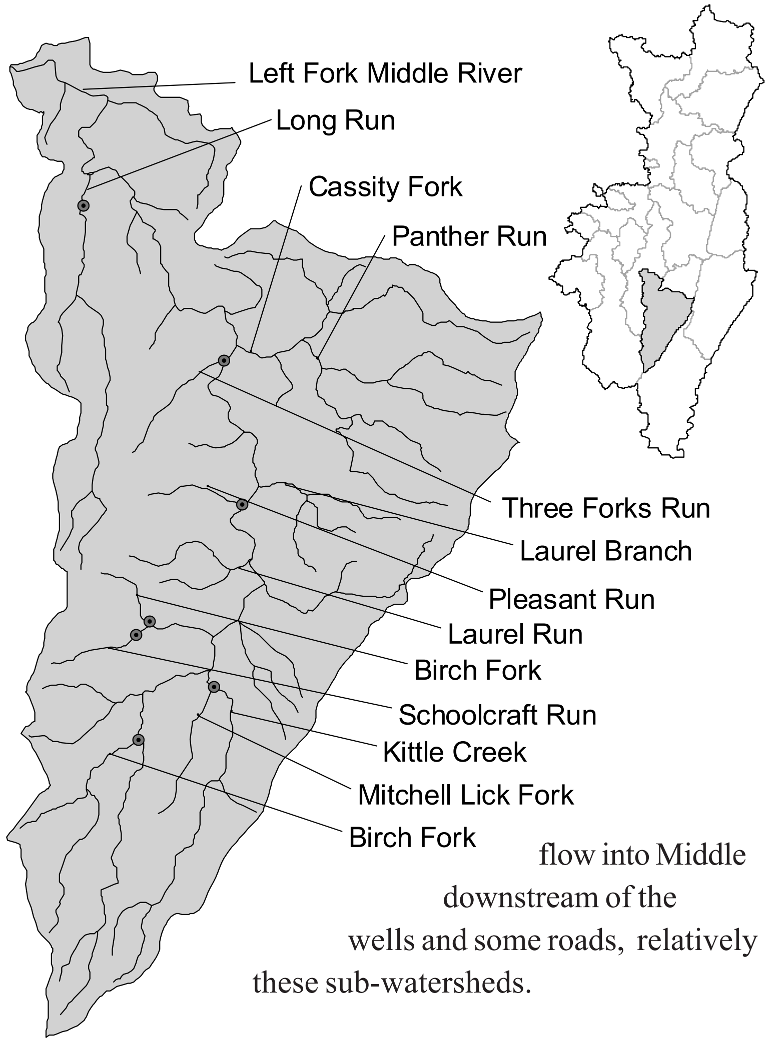
The WVSCI score of Shooks Run was low at 26.7. However, the benthic sample was not comparable because the assessment team employed the MACS technique due to a dearth of riffle/run habitat. The site was embedded with sand and silt, therefore it was necessary to sample by sweeping the D-net through overhanging vegetation, generally considered poor habitat. The sample produced a total taxa score of only 11. There were no mayfly, stonefly, or caddisfly taxa in the sample (EPT = 0). Individuals of the midge family *Chironomidae* were the most abundant benthic organisms collected, comprising 71.4% of the entire sample. Even though the benthic sample was not comparable to riffle/run sites, it appeared to be impaired. Certain poor benthic habitat parameters and the disturbances associated with the urban environment were likely causes.

Two sites with WVSCI scores indicating they were not benthologically impaired, had bacteria concentrations in violation of the water quality criterion. Jones Run had a bacteria concentration of 472/100mL, while the WVSCI score was 78.18. The WCMS indicated the presence of agricultural activities, that may have included livestock pastures, in the headwaters of this stream. Chenoweth Creek had a bacteria concentration of 920/100mL, while the WVSCI score was 76.96. The WCMS indicated the presence of agricultural activities in the headwaters of this stream, possibly including pastures. Additionally, the community of Glenmore is located above the assessment site, raising the possibility of domestic sewage as a bacteria source.

One of the two Tygart Valley River mainstem sites (WVM-27-{83.0}) sampled in this sub-watershed had a bacteria concentration (1,269 col/100mL) exceeding the water quality criterion. This site is located in the city of Elkins approximately 0.5 miles downstream of the CSX Transportation rail yard. There was a variety of possible sources of bacteria along the river, including untreated domestic sewage and agriculture.

Left Fork of Middle Fork River Sub-watershed

The Left Fork of Middle Fork River (considered by some to be the mainstem above the Right Fork) sub-watershed was sampled at seven locations. This sub-watershed has several tributaries with historical AMD problems, including Cassity Fork, Three Forks Run, and Panther Run.



The Section's sampling teams assessed two sites that are in the WVDEP statewide reference site database. Schoolcraft Run and Birch Fork received optimal RBP habitat scores and WVSCI scores indicating they were unimpaired. The waters of these streams flow into Middle Fork River approximately 0.7 miles downstream of the community of Adolph. Excluding oil/gas wells and some roads, relatively few human disturbances are found within these sub-watersheds.

Rocky Run (WVMTM-26-B) was sampled near its mouth. Rocky Run is a tributary of Birch Fork, which joins Kittle Creek near Adolph and forms the Middle Fork River. This site received an optimal RBP habitat (score = 197). However, the benthic macroinvertebrate data indicated the site was impaired, producing a WVSCI score of 55.19. Most of the Rocky Run sub-watershed was forested (largely coniferous) with some oil/gas activity and roads, but no mining (WCMS). A low conductivity reading (59 µmhos/cm) and a benthic sample typical of acid rain impairment (i.e., total taxa = 10, EPT Index = 6) made Rocky Run a good candidate for the 303(d) list, so it was placed thereupon in 2002. Birch Fork was placed on the 1998 list for acid rain impaired streams based upon historical data. No TMDL has been developed for either Birch Fork or Rocky Run.

Three Forks Run was assessed near its mouth, where it flows into the Middle Fork River. This site is about 0.4 miles upstream of the village of Cassity. Land use within the sub-watershed included mining, oil/gas activity, and some agriculture. A WVSCI score of 48.02 indicated this site was impaired. The assessment team noted the presence of a coal mine refuse pile beside the stream. A

Table 8. Left Fork of Middle Fork sub-watershed sites				
Stream Name	ANCODE	WVSCI	RBP	Fecal
LONG RUN	WVMTM-13-{0.8}	78.30	145	20
MITCHELL LICK FK	WVMTM-27	N/C	145	0
ROCKY RUN	WVMTM-26-B	55.19	197	1
BIRCH FORK	WVMTM-25-A	87.40	194	20
SCOOLCRAFT RUN	WVMTM-25-{1.5}	84.19	199	140
PLEASANT RUN	WVMTM-21	60.99	167	80
THREE FORKS RUN	WVMTM-17	48.02	126	200
WVSCI scores in gray blocks indicate impairment. N/C = non-comparable.				

mine drainage treatment project near the assessment site suggested that Three Forks Run was receiving treated mine drainage. Other disturbances in the area included power lines, a dirt road, riprap, and stream channelization. A layer of whitish-gray material covered the stream substrate. A pH reading of 8.6 suggested that the stream was being treated with an alkaline based material. Although benthic diversity was fair (total taxa = 15), the sample was dominated by tolerant *Chironomidae* midges and *Tipulidae* craneflies (Percent 2 Dominant Taxa = 70.3). In addition, the percent of EPT taxa in the sample was only 8.9.

Pleasant Run was assessed near its confluence with the Middle Fork River. The WVSCI score (60.99) was in the gray zone and the RBP habitat assessment resulted in a suboptimal score (167). This drainage was mostly forested with some oil/gas disturbances. A local landowner informed the assessment team that clear-cut timbering was occurring in the headwater areas of Pleasant Run. Disturbances at the site were minimal, an old field on the left bank and a small ATV trail on the right bank. Water quality field measurements failed to provide clues pointing to potential sources of impairment. It should be noted that the low flow conditions in Pleasant Run may have reduced benthic sampling efficiency by preventing organisms from washing into the net. However, no notations to this effect were made by the assessment team. In order to obtain a more certain measurement of biological health, Pleasant Run should be assessed again when stream flow is more conducive to collecting a benthic macroinvertebrate sample.

Water samples were collected at all eight sites in the Middle Fork River sub-watershed for the analyses of fecal coliform bacteria. None of the sites had bacteria concentrations exceeding the state water quality criterion.

From Mitchell Lick Fork, the assessment team collected only five of the eight surber kick net samples required to make the results comparable to those of other riffle/run sampled sites. The WVSCI score (73.85) resulting from this partial sampling indicates no impairment. While it is conceivable that three more kick net samples could have caused the WVSCI score to be lower, this scenario is very unlikely. The benthic metrics developed from this partial sample indicate the site was truly unimpaired. The "% EPT" was relatively high (63.86). Although pollution tolerant taxa (*Chironomidae* & *Hydropsychidae*) were the two dominant taxa, the relatively high percentage of EPT taxa indicate a relatively high diversity within the benthic community.

Right Fork of Middle Fork River Sub-watershed

The Section's teams conducted assessments at three sites in the Right Fork of Middle Fork sub-watershed that are in the WVDEP statewide reference site database. Two tributaries, Jenks Run and Hanging Run, received optimal (score = 191) and suboptimal (score = 173) RBP habitat scores, respectively. These sites also received unimpaired WVSCI scores (Jenks Run = 78.92 & Hanging Run = 77.6). Jenks Run flows into the Right Fork of Middle Fork approximately 1.5 miles upstream of the community of Queens. Hanging Run's confluence with the Right Fork of Middle Fork is approximately 3.3 miles upstream of Audra State Park. These drainages were mostly forested, but also host to some agriculture, oil/gas activity, and roads. A site assessed on the mainstem of Right Fork of Middle Fork (WVMTM-11-{7.6}) also serves as a reference site for the Section. This site is located approximately 1.5 miles downstream of the community of Hemlock. The drainage area above the sampling point was mostly forested with some oil/gas activity, agriculture, and roads. The RBP habitat score (206) was optimal and the WVSCI score (86.42) indicated that the site was unimpaired.

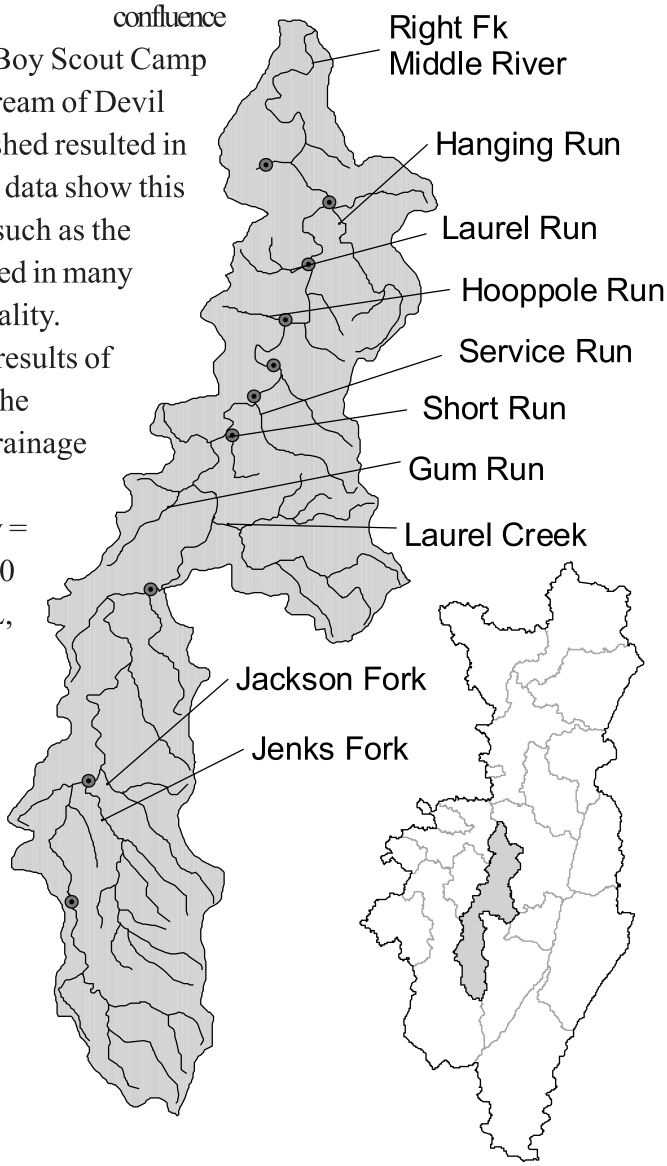
Hooppole Run was the only stream in the Right Fork of Middle Fork sub-watershed to receive a WVSCI score (46.56) in the impaired category. The entire length of Hooppole Run is adjacent to the new U.S. Rt. 33 four-lane highway (Appalachian Corridor H) that connects the towns of Buckhannon and Elkins. Construction activities associated with this highway have resulted in substantial degradation to the water quality and habitat at the sampling site. The assessment team indicated the site had been heavily channelized, with riprap placed on both sides of the stream for bank stabilization. Oil was present on the stream's surface and in the sediment deposits. Iron hydroxide deposits were observed in the assessment area. There was no stream surface shade, because the natural vegetation within the riparian zone had been removed. The stream pH (5.95) violated the water quality criterion. However, the sample had a net alkalinity, albeit quite low (6 mg/L and total alkalinity only 8 mg/L). Iron (3.80 mg/L) and manganese (4.10 mg/L) concentrations violated the state water quality criteria. Benthic diversity (total taxa = 3) and abundance of individuals (9 organisms in the entire sample) were very low.

In addition to the reference site location, another Right Fork of Middle Fork (WVMTM-11-{0.3}) site was sampled near its confluence with the Middle Fork River mainstem. This site had a suboptimal RBP habitat score (176). The WVSCI score (74.22) was less than the reference site score, but indicated that the site was unimpaired. The observed difference in the WVSCI scores between this site and the mainstem reference site may have been associated with land use. Assessment team members noted that this lowermost site had oil/gas activity, some agriculture, roads, mining, and residences. Compared to the Right Fork reference site, alkalinity concentration was lower and concentrations of iron, manganese, and zinc were slightly higher. However, the concentrations of these metals were not indicative of major mine drainage pollution (iron = 0.310 mg/L, manganese = 0.042 mg/L, & zinc = 0.046 mg/L). An examination of the benthic macroinvertebrate data revealed

Table 9. Right Fork of Middle Fork sub-watershed sites				
Stream Name	ANCODE	WVSCI	RBP	Fecal
SHORT RUN	WVMTM-7	79.80	166	12
RIGHT FK/MIDDLE FK	WVMTM-11-{0.3}	74.22	176	249
RIGHT FK/MIDDLE FK	WVMTM-11-{7.6}	86.42	206	0
JENKS RUN	WVMTM-11-E	78.92	191	304
LAUREL RUN	WVMTM-2	85.65	164	225
HOOPPOLE RUN	WVMTM-3	46.56	153	0
SWAMP RUN	WVMTM-0.5-{0.6}	74.68	191	751
HANGING RUN	WVMTM-1	77.60	173	117
MIDDLE FORK RIVER	WVMT-33-{11.8}	65.10	193	123
SERVICE RUN	WVMTM-5	75.55	161	63
Sites in gray blocks have WVSCI scores indicative of impairment				

that the sample was dominated by two taxa, the caddisfly family *Hydropsychidae* and the beetle family *Elmidae* (Percent 2 Dominant Taxa = 59.1). However, the diversity of taxa was considered relatively good (total taxa = 19) and the sample had several mayfly, stonefly, and caddisfly representatives (EPT Index = 10).

The Section's sampling team assessed a site on the mainstem of the Middle Fork River approximately 11.8 miles upstream of its confluence with the Tygart Valley River. The site is near the Boy Scout Camp Mahonegan entrance sign about 0.3 miles downstream of Devil Run. Mining in the Middle Fork River sub-watershed resulted in severe degradation to its water quality. Historical data show this to be true. Treatment projects for mine drainage such as the application of "limestone fines" have been employed in many areas of the drainage and have improved water quality. Evidence for this contention was provided by the results of water samples analyzed for mine drainage during the Section's assessment. None of the typical mine drainage parameters resulted in values indicating severe impairment (pH = 7.45, conductivity = 89, acidity = not detected, alkalinity = 20.0 mg/L, sulfate = 17.0 mg/L, aluminum = 0.080 mg/L, iron = 0.230 mg/L, & manganese = 0.064 mg/L). The RBP habitat score was optimal (193) and the WVSCI score was in the gray zone (65.1). Because this score fell within the gray zone, additional samples would be necessary to confidently rate the site's benthological condition. However, an examination of the individual metric scores suggested that the benthic macroinvertebrate community was stressed. Diversity was relatively low (total taxa = 10) and the number of mayfly, stonefly, and caddisfly taxa (EPT Index = 6) was lower than would be expected for an unimpaired

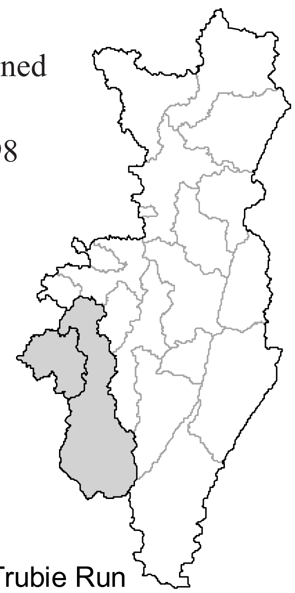


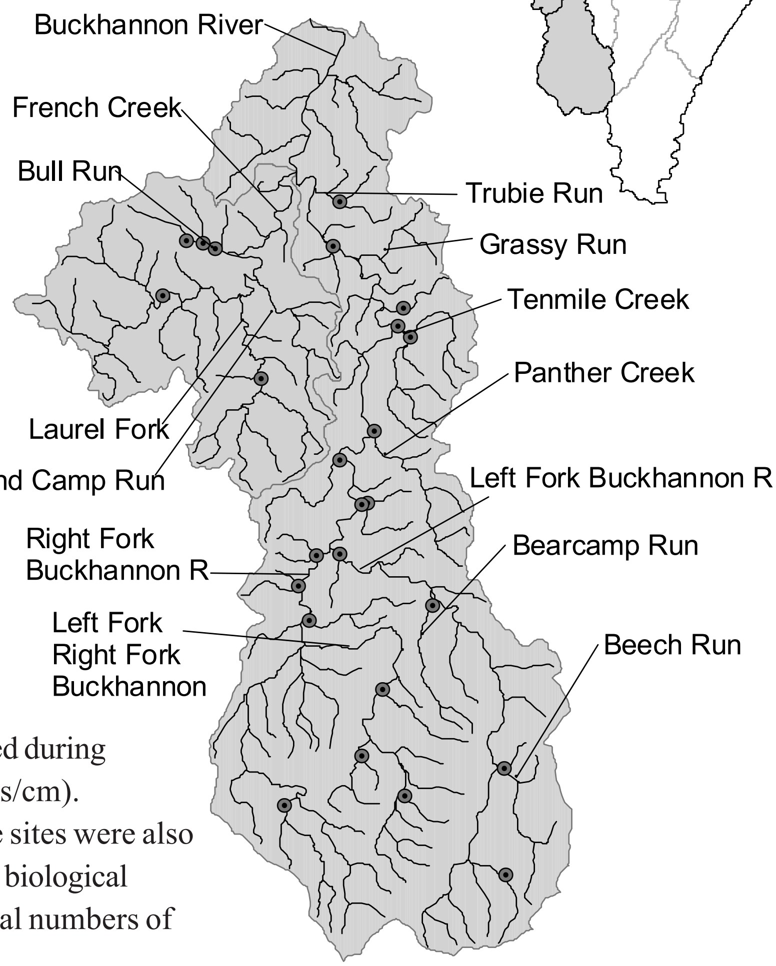
stream. Stoneflies were not present in the sample.

At all 10 sites in the Right Fork of Middle Fork River sub-watershed, water samples were collected for the analyses of fecal coliform bacteria. The only site that produced a violation of the water quality criterion, Swamp Run, had a concentration of 751/100mL. Possible sources of bacteria upstream of the sample point included agricultural activities and residences (WCMS).

Upper Buckhannon River Sub-watershed

Large areas of the Upper Buckhannon River sub-watershed have been mined for coal. This has resulted in significant degradation to water quality in this drainage area. In fact, the Buckhannon River mainstem was placed on the 1998 303(d) list for impairment caused by mine drainage. The 303(d) list targeted a segment that extends from the forks of Buckhannon River downstream to French Creek, a total of 16.74 miles. Toxic concentrations of metals and low pH values were given as the causes of degradation. A TMDL was developed for this section in 1998.





Several streams in the Upper Buckhannon River sub-watershed that were on the 1998 303(d) list for impairment by acid rain, were assessed. Three of these streams were assessed at sites that received WVSCI scores indicating they were unimpaired (Right Fork of Buckhannon River = 73.53, Marsh Fork = 75.92, & Beech Run = 73.95). These sites had relatively few disturbances and human activities. The pH measurements were similar, with values recorded near 7.0 for each site. Conductivity measurements were also similar, with relatively low values recorded during the assessment (range = 41 to 119 µmhos/cm). Benthic macroinvertebrate data for these sites were also similar and indicative of relatively healthy biological conditions. All three of the sites had equal numbers of mayfly, stonefly, and caddisfly taxa (EPT Index = 9). Total taxa scores ranged from 14 at Beech Run to 15 at Right Fork and Marsh Fork. Based on these assessment data, it did not appear that acid rain was causing a substantial negative impact to the benthic macroinvertebrate community at these sites. The WCMS identified mining activities in each of these stream's drainage areas, but no negative impacts to these sites were noted. Right Fork of Buckhannon River was removed from the 303(d) list based upon these and other data. The other two streams were retained and will be studied further to determine their appropriate statuses.

Bear Camp Run was assessed near its mouth, where it flows into Left Fork of Buckhannon River about 1.2 miles downstream of Palace Valley. The watershed of Bear Camp Run was mostly forested with some oil/gas activity, roads, and agriculture. This stream was placed on the 1998 303(d) list for acid rain impairment. The benthic sample received a WVSCI score in the gray zone (62.52). Except for an old jeep trail along the right bank, relatively few disturbances were noted in the assessment area. The RBP habitat assessment score was in the optimal range (score = 181). Erosion within the local assessment area was slight and there was no evidence of non-point source pollution. Cobble and gravel were abundant on the substrate, producing excellent benthic habitat. The low conductivity (34 µmhos/cm) suggested potential impairment by acid precipitation during runoff events, but pH (6.4) did not reflect impairment at the time of sampling. The low conductivity measurement indicates that Bear Camp Run was relatively infertile with a limited capacity for neutralizing acid. The benthic sample displayed characteristics of acid impairment. Diversity was fair (total taxa = 13) and the number of mayfly, stonefly, and caddisfly taxa (EPT Index = 7) was considered slightly low.

Table 10. Upper Buckhannon River sub-watershed sites

Stream Name	ANCODE	WVSCI	RBP	Fecal
FRENCH CREEK	WVMTB-18-{11.2}	N/C	163	340
BULL RUN	WVMTB-18-B	56.44	143	596
BLACKLICK RUN	WVMTB-18-B-2	N/C	143	468
MUDLICK RUN	WVMTB-18-B-3	41.84	123	1400
LAUREL FORK/FRENCH CK	WVMTB-18-D-{3.9}	78.62	181	160
TRUBIE RUN	WVMTB-19-{0.9}	77.74	168	180
SAWMILL RUN	WVMTB-20	52.30	162	70
LAUREL RUN	WVMTB-24	56.35	154	620
TENMILE CREEK	WVMTB-25	49.49	147	2
RIGHT FORK/TENMILE CK	WVMTB-25-A	75.69	166	16
PANTHER FORK	WVMTB-27	59.51	137	2
BIG RUN	WVMTB-28	64.37	160	191
SWAMP RUN	WVMTB-29	N/C	175	1
HERODS RUN	WVMTB-30	68.57	184	400
RIGHT FK/BUCKHANNON R	WVMTB-31	73.53	189	20
ALEC RUN	WVMTB-31-C	77.86	188	40
MILLSITE RUN	WVMTB-31-D	77.63	183	41
TROUT RUN	WVMTB-31-F-1	70.03	162	5
UPPER TROUT RUN	WVMTB-31-F-2-{0.8}	82.35	158	5
SALT BLOCK RUN	WVMTB-31-F-5	80.06	140	7
MARSH FORK	WVMTB-31-J	75.92	194	20
LEFT FK/BUCKHANNON R	WVMTB-32-{0.4}	76.51	184	1
LEFT FK/BUCKHANNON R	WVMTB-32-{0.4}	77.20	162	14
BEAR CAMP RUN	WVMTB-32-D	62.52	181	24
BEECH RUN	WVMTB-32-H	73.95	187	7
PHILLIPS CAMP RUN	WVMTB-32-I-1	79.20	195	0

Sites in gray blocks have WVSCI scores indicative of impairment.

Left Fork/Buckhannon River was assessed twice at the same location for quality control measures. This included duplicate samples for benthic macroinvertebrates. The majority of the drainage area above the sample point was forested, with mining, oil/gas activity, agriculture, and roads (WCMS) also present as possible stressors. Left Fork is on the 1998 303(d) list for impairments caused by mine drainage (pH) and acid rain. Disturbances at the assessment site were limited to a power line, a bridge, and a railroad. Local watershed erosion was rated as slight and iron hydroxide deposits were scattered in areas of the assessment reach. One team observed flecks of oil on the stream's surface and rated the sediment oil as moderate. The other team noted no oil flecks, but rated the sediment oil as slight. Cobble and gravel were common in the stream and provided excellent habitat for benthic macroinvertebrates. RBP habitat was rated optimal (184) by one assessment team and suboptimal (162) by the other. Field and laboratory physicochemical analyses failed to indicate that mine drainage was causing a substantial negative impact to the water quality of Left Fork (pH = 7.6 & 6.92, conductivity = 71 & 72 μmhos/cm, acidity = not detected at a minimum detection limit of 1 mg/L, alkalinity = 15.0 mg/L, sulfate = 15.0 mg/L, aluminum = not detected, iron = 0.140 mg/L, & manganese = not detected. Left Fork was placed on the 1998 303(d) list for impairments caused by mine drainage (pH) and acid rain. However, data collected at this site indicated that any suspected impairment was not severe. In fact, the two WVSCI scores calculated from the duplicate samples indicated the site was unimpaired (77.2 and 76.51).

The Section's sampling team conducted an assessment at one location on Herods Run near its confluence with the Buckhannon River. The mouth of Herods Run is located about 1.8 miles upstream of Alton. Most of the drainage area was forested, but some mining was located in the headwater areas (WCMS). Evidence of logging activity was observed a short distance downstream of the assessment area. This stream was included on the 1998 303(d) list for pH impairment caused by mine drainage. The WVSCI score (68.57) barely exceeded the gray zone threshold, so the site was considered unimpaired. Man-made disturbances in the assessment reach were minimal. Local watershed erosion was rated as slight and sand was present throughout the reach in moderate amounts. The downstream terminus of the reach was described as flat water with beaver activity. The RBP habitat assessment was optimal with a score of 184. "Channel flow status" was given a marginal score (8) indicating that the water level was relatively low. The conductivity reading was relatively low (86 μmhos/cm) indicating that the stream had relatively low concentrations of dissolved ions. Although the site on Herods Run received an unimpaired WVSCI score, the benthic data suggested this stream was not without some impairment. This was evident in the relatively low diversity of mayflies, stoneflies, and caddisflies (EPT Index = 5). Additionally, the sample was dominated by two generally pollution tolerant taxa, the caddisfly family *Hydropsychidae* and the midge family *Chironomidae* (Percent 2 Dominant Taxa = 62.7). It should be noted that the low flow conditions at this site could have reduced benthic sampling efficiency, and thus might have inaccurately reflected the impairment status of the stream. Herods Run needs to be assessed more intensively in order to determine its biological condition.

Swamp Run was assessed at one location near its confluence with the Buckhannon River. The mouth of Swamp Run is about 1.7 miles upstream of the village of Alton. Although the majority of its drainage area is forested, mining has caused considerable damage to the water quality of this stream. Consequently, Swamp Run was placed on the 1998 303(d) list for impairment by pH and metals, with mine drainage identified as the source. Disturbances at the assessment site included pipes/drains, logging, parking areas, and roads. A mine drainage treatment pond was located on the right bank and was discharging effluent into Swamp Run a few meters above the assessment site. Sediment deposits included sand and metal hydroxides. Despite the numerous disturbances at the site, the RBP habitat assessment resulted in a high suboptimal score (175). A complete benthic macroinvertebrate sample was not collected. However, the assessment team did collect one kick sample and examined the contents for macroinvertebrate life while at the site. There were no organisms found in the contents of the single kick sample. This suggests that the site was biologically impaired. The team attributed the impairment to mine drainage. A field reading of pH (3.6) indicated that the water was in violation of the state water quality standards. Results of laboratory analyses were also indicative of mine drainage with aluminum and manganese concentrations in violation of state water quality standards (respectively, alkalinity = not detected, acidity = 61.0 mg/L, sulfate = 220.0 mg/L, aluminum = 7.500 mg/L, iron = 0.300 mg/L, manganese = 5.300 mg/L).

Big Run was assessed near its mouth. This stream flows into the Buckhannon River at the village of Alton. The WVSCI score was in the gray zone (64.37). Land use included primarily forest cover, but also some agriculture, mining, oil/gas, and roads. The assessment site was located in a residential area with a garden on the left bank and a residence on the right. A newly reconstructed railroad bridge crossed the stream near the lower end of the assessment reach. Other disturbances included lawns, power lines, and roads. Local watershed erosion was rated as slight and there was a high abundance of periphyton and algae. Sediment deposits included silt and sand. The RBP habitat assessment resulted in a suboptimal score (160). The benthic macroinvertebrate data suggested that this site may have been nutrient enriched, since nutrient loving taxa (*Chironomidae* and *Simuliidae*) dominated the sample (Percent 2 Dominant Taxa = 57.7). Additionally, the HBI score of 5.2 suggested that organic pollution was likely impacting the benthic community. The fact that periphyton/algae were heavy in the stream supports this contention. Water samples were not collected for nutrient analyses. Big Run needs to be assessed more intensively in order to determine its biological condition.

Panther Fork was assessed near the mouth. This stream flows into the Buckhannon River at the community of Beans Mill. The drainage area of Panther Fork is mostly forested, with mining, oil/gas, and roads as other land uses (WCMS). The stream was included on the 1998 303(d) list for pH impairment resulting from mine drainage. The WVSCI score (59.51) indicated that the benthic macroinvertebrate community was impaired. Local watershed erosion was rated as moderate and the abundance of periphyton/algae was high. The RBP habitat assessment resulted in a suboptimal score (137). "Sediment deposition" was a problem within the stream reach and was given a marginal score

(6). “Channel flow status” was given a marginal score (6) indicating that the stream flow was relatively low. The pH (5.9) was in violation of the water quality standard. Water sample analyses did not produce results showing high concentrations of metals (aluminum = 0.067 mg/L, iron = 0.098 mg/L, manganese = 0.066 mg/L). However, the alkalinity (4.0 mg/L) was low and the value was nearly matched by the sample’s acidity (3.0 mg/L). The benthic macroinvertebrate data were suggestive of pH impairment. Compared to values expected in unimpaired streams, the diversity was lower (total taxa = 13) and the number of mayfly, stonefly, and caddisfly taxa was lower (EPT Index = 6). Also, there was only one mayfly taxon represented (*Ephemerellidae*) in the sample. The sample was dominated by *Hydropsychidae* caddisflies and *Chironomidae* midges (Percent 2 Dominant Taxa = 71.0).

The Section's sampling team assessed two sites in the Tenmile Creek drainage. One of the sites is on Tenmile Creek near its mouth. Right Fork/Tenmile Creek was assessed near its confluence with Tenmile Creek. Mining has caused severe degradation to the water quality of more than one stream within the Tenmile Creek sub-watershed. Tenmile Creek was included on the 1998 303(d) list for impairment by mine drainage, with aluminum and iron listed as pollutants. A TMDL was developed the same year for Tenmile Creek. Right Fork/Tenmile Creek was placed on the 303(d) list for pH impairment caused by acid rain. A TMDL will be developed in 2010.

The WVSCI score (49.49) for the Tenmile Creek site indicated that the benthic macroinvertebrate community was impaired. Disturbances at the site included a residence, lawn, and a limestone gravel road. Local watershed erosion was heavy and algae/periphyton abundance was rated as high. Sediment deposits included silt and iron hydroxides. The RBP habitat assessment score was in the suboptimal category (147). “Embeddedness” in the stream reach was given a marginal score (9). The habitat parameters “grazing or other disruptive pressure” (score = 8) and “riparian vegetation zone width” (score = 7) were rated as marginal. Water quality data were indicative of mine drainage (pH = 5.8, conductivity = 1,590 µmhos/cm, acidity = 6.0 mg/L, alkalinity = 4.0 mg/L, sulfate = 1,200.0 mg/L). Although the concentrations of aluminum (0.240 mg/L), iron (0.780 mg/L), and manganese (1.30 mg/L) did not exceed the state water quality standards, they were slightly higher than would have been expected for an unimpaired stream. The benthic macroinvertebrate data were suggestive of mine drainage, since the entire sample contained only 66 individual organisms. Diversity was low (total taxa = 8). There were no mayfly or stonefly representatives in the sample, which resulted in a poor EPT Index (2). The sample was dominated by *Hydropsychidae* caddisflies and *Chironomidae* midges (Percent 2 Dominant Taxa = 87.9).

The WVSCI score (75.69) for the site on Right Fork/Tenmile Creek indicated that it was not impaired. Although this stream had mining activity in its drainage area, the assessment data did not indicate resultant negative impacts. Furthermore, there was no indication that acid rain was causing negative impacts to Right Fork/Tenmile Creek. The pH was nearly neutral (7.1). Benthic data indicated that the stream was fairly healthy, with relatively high diversity (total taxa = 16) and several mayfly, stonefly, and caddisfly taxa (EPT Index = 9). Three of the taxa were mayfly families, which are generally intolerant of acid conditions.

Laurel Run (WVMTB-24) was assessed at one location approximately 0.5 miles upstream from its confluence with the Buckhannon River. The mouth of Laurel Run is about 1.1 miles downstream of the community of Tenmile. Land use included forest cover, agriculture, mining, oil/gas, and roads. Disturbances at the assessment site included gas lines and a gravel road. Sediment deposits included sand and silt. Cattle were observed upstream of the assessment reach. The WVSCI score (56.35) calculated for this site indicated that it was impaired. Diversity was low (total taxa = 6). The EPT Index was very low (3), with only one mayfly taxon (*Heptageniidae*) and two caddisfly taxa (*Hydropsychidae* and *Philopotamidae*) represented in the sample. *Hydropsychidae* caddisflies were dominant and comprised nearly 73.0 % of the sample. These benthic data suggest that Laurel Run may have been nutrient enriched. A likely source could have been cattle wastes entering the stream from agricultural areas above the sample point. Field measurements of water quality failed to provide clues on the observed biological impairment (pH = 7.6, conductivity = 121 µmhos/cm, & D.O. = 8.6 mg/L). However, a single fecal coliform bacteria sample revealed a violation of the state water quality criterion with a concentration of 620/100mL. Agricultural activities could have been responsible for the high concentration of bacteria.

The Section's sampling team assessed Sawmill Run near its confluence with the Buckhannon River. The mouth of Sawmill Run is located about 0.8 miles upstream of the village of Sago. This site received an impaired WVSCI score (52.3). Land use in the mostly forested Sawmill Run drainage area included mining, agriculture, oil/gas, and roads (WCMS). Observations of disturbances at the assessment site included railroad tracks, powerlines, and roads. The abundance of periphyton/algae was rated moderate. Benthic substrate was good with some deposits of sand and silt. The RBP habitat assessment score was suboptimal (162). "Channel flow status" was rated as marginal (score =10) and "riparian vegetation zone width" was poor (score = 5). Although the pH (7.4) of the stream hinted that it was not acidic, a measure of sulfate (350.0 mg/L) suggested that mine drainage was negatively impacting Sawmill Run. Concentrations of iron (0.370 mg/L) and manganese (0.150 mg/L) were also slightly high. The benthic data also suggested that mine drainage was negatively impacting Sawmill Run. The total taxa score (5) was quite low, with only one mayfly (*Baetidae*) and no stonefly taxa present in the sample. The sample was dominated by *Hydropsychidae* caddisflies and members of the blackfly family *Simuliidae* (Percent 2 Dominant Taxa = 90.6).

French Creek is a major tributary the Upper Buckhannon River. This stream flows into the Buckhannon River near the community of Hampton. Sampling teams conducted assessments at five sites in the French Creek sub-watershed, including one on the mainstem.

Laurel Fork (WVMTB-18-D-{3.9}) received a WVSCI score (78.62) that indicated it was unimpaired.

Mudlick Run was assessed approximately 0.3 miles upstream of its confluence with Bull Run. The mouth of Mudlick Run is approximately 0.9 miles west of the town of Adrian. It was included on the 1998 303(d) list for impairment by iron, with mine drainage indicated as the source. The site received a WVSCI score (41.84) that indicated it was quite impaired. Land use included agriculture, oil/gas, and roads (WCMS). Observations of disturbances at the assessment site included residences, lawns, pasture, livestock access, and roads. The site was surrounded by a pasture with no large trees in the riparian zone to provide stream surface shading. Local watershed erosion was rated as high and silt was present in moderate abundance. There was a high abundance of periphyton/algae and deposits of livestock manure were observed in the stream. The RBP habitat assessment was marginal with a score of 123.

The assessment team collected a water sample to determine if mine drainage was impacting Mudlick Run. Although the concentration of iron was slightly high, mine drainage did not appear to be negatively impacting the stream at the assessment site (acidity = not detected, alkalinity = 50.0 mg/L, sulfate = 5.0 mg/L, iron = 1.2 mg/L, aluminum = 0.17 mg/L, & manganese = 0.13 mg/L).

The data collected from Mudlick Run suggest that organic enrichment may have been negatively impacting the site. Evidence of this was indicated by a high abundance of algae/periphyton, livestock manure in the stream, and a high concentration of fecal coliform bacteria in the water (1,400/100mL). A single grab-sample of water was collected at the site and analyzed for total phosphorus (0.02 mg/L) and nitrate+nitrite nitrogen (0.20 mg/L). The results do not indicate that there were high levels of either nutrient in the stream. However, the Section's single grab-sample was not collected during or soon after a heavy precipitation event, a time when high nutrient levels are generally more likely to be detected. An examination of the benthic macroinvertebrate data also suggested that organic enrichment might have been impacting the site. Although the total taxa at this site was relatively high (17), 59.0% of the sample was composed of *Chironomidae* midges. These organisms are generally considered to be tolerant of excessive nutrient concentrations and often respond by becoming dominant in the community. There were no mayflies or stoneflies in the sample. Additionally, the HBI score at this site was relatively high with a value 6.06. This metric was specifically developed as a means of detecting organic enrichment in benthic communities. A score of 6.06 indicates that organic enrichment was likely occurring.

The assessment team sampled Blacklick Run near its mouth. This stream is a tributary of Bull Run and is located about 0.6 miles upstream from the town of Adrian. It was included on the 1998 303(d) list for impairment by iron, with mine drainage as the source. There are numerous disturbances within its drainage including mining, oil/gas, agriculture, a landfill, residences, and roads (WCMS). Disturbances observed at the study site included an old surface mine, rip/rap for bank stabilization, and channelization of the stream. Sediment deposits included sludge, sand, and silt. The RBP habitat assessment resulted in a suboptimal score (143). The assessment team noted the presence of heavy deposits of iron hydroxide on the stream substrate.

It appeared as though Blacklick Run was being treated for mine drainage at a location upstream of the assessment site. The pH at the site was near neutral (7.2), conductivity was high (1,453 µmhos/cm), alkalinity was high (280.0 mg/L), and hot acidity was not detected. The high alkalinity was likely due to the use of an alkaline material to neutralize acidic mine drainage. The concentration of iron (3.60 mg/L) violated the state water quality criterion of 1.5 mg/L. Sulfate was excessive with a value of 960.0 mg/L.

The benthic macroinvertebrate sample was not comparable because there was not enough riffle habitat to make a complete eight kick collection. As a result, five riffles were kicked, and the remainder of the sample was obtained by using the MACS method to jab aquatic vegetation. An examination of the individual benthic organisms that were collected suggested the stream was severely impaired. Individuals of only two taxa were found in the sample. One taxon was the snail family *Planorbidae*, with 14 individuals in the sample. Seven midges comprised the other taxon, *Chironomidae*. In an unimpaired stream, it would be reasonable to assume that the sampling techniques used at the site on Blacklick Run would have resulted in greater diversity and abundance of benthic macroinvertebrates.

Although no nutrient analyses were performed on the Blacklick Run water sample, nutrient enrichment may have been a cause of the benthic community's low diversity. There were agricultural activities in the Blacklick Run drainage. The concentration of fecal coliform bacteria (468/100mL) violated the state water quality standard.

Bull Run was assessed at one location approximately 0.3 miles upstream of its confluence with French Creek near the town of Adrian. The site was about 0.4 miles downstream of Blacklick Run. It was included on the 1998 303(d) list for impairment by iron, with mine drainage identified as the source. Land use above the assessment site included mining, oil/gas, agriculture, residential areas, a major powerline crossing, and roads (WCMS). Observations of disturbances and activities at the assessment site include a powerline, roads, an old school, and stream channelization. Local watershed erosion was rated as moderate and there was a high abundance of periphyton/algae. Sediment deposits included sand, silt, and some iron hydroxide. Overall, the RBP habitat was suboptimal with a score of 143.

Similar to Blacklick Run's water quality analyses, those from Bull Run were indicative of treated acid mine drainage. The pH and conductivity were relatively high (respectively, 7.8 & 1,312 µmhos/cm), alkalinity was significantly elevated (290.0 mg/L), and hot acidity was not detected. The concentration of iron (2.40 mg/L) violated the state water quality criterion of 1.5 mg/L. Sulfate was relatively high with a value of 560.0 mg/L.

Although Bull Run appeared to be less impaired than the site on its tributary (Blacklick Run), a WVSCI score of 56.44 indicated it was, indeed, impaired. The EPT Index (3) was low with only one mayfly specimen and two caddisfly taxa in the sample. The sample was dominated by two taxa, *Hydropsychidae* caddisflies and *Chironomidae* midges (81.2%).

Mine drainage appeared to be the primary cause of impairment to Bull Run at this site. However, other potential causes of impairment, such as domestic sewage, agriculture, and oil/gas activities, should not be discounted as potential sources. The fecal coliform bacteria concentration at this site (596/100 mL) exceeded the state water quality criterion.

The Section's sampling team conducted an assessment at one location on French Creek approximately 1.0 mile upstream from the town of French Creek. The drainage area above the assessment site is approximately 15 square miles. Land use included agriculture, oil/gas, residential areas, and roads (WCMS). There was also a major powerline crossing. One WVDEP permitted discharge was located above the assessment site, the West Virginia Division of Natural Resources' general sewage permit at the WV State Wildlife Center. The effluent from this facility discharged into a small tributary of Left Fork of French Creek. Activities and disturbances near the study site included a residence, a lawn, and an oil/gas well. Local watershed erosion was rated as slight and there was a moderate abundance of periphyton/algae. Deposits of sand and silt were heavy. The RBP habitat assessment resulted in a suboptimal score (163). Except for a relatively low concentration of dissolved oxygen (5.4 mg/L), the water quality at this site appeared to be good.

The benthic sample was not comparable because the MACS method of collection was used. The method consisted of 15 jabs in woody snag habitat and five jabs in overhanging vegetation. The assessment was conducted at a sluggish section of French Creek. Such streams often produce macroinvertebrates representative of both streams and ponds. French Creek's benthic sample produced 17 taxa, seven of which were in the EPT group. None of the EPT taxa were stoneflies, but this is not unusual for slow moving waters. Four families (*Aeshnidae*, *Gomphidae*, *Calyopterygidae*, *Coenagrionidae*) in the order *Odonata* were represented in the sample. This order contains the dragonflies and damselflies, organisms more often found in pond environments. Because the Section did not have reference conditions for this type of habitat, a comparable WVSCI score could not be calculated. However, given the diversity of macroinvertebrates collected at the site, the condition of French Creek at the assessment site appeared to be unimpaired. Comparable riffle/run samples should be collected from French Creek during future sampling efforts.

Lower Buckhannon River Sub-watershed - Including Pecks Run, Finks Run, and Sand Run Sites

There were 16 assessments conducted in this sub-watershed that is primarily located to the north and east of the Upshur County seat of Buckhannon. There is a substantial amount of agricultural activity in the central and western portions of this area. The sub-watershed is 70 percent forested and most of the remainder, nearly 28 percent, is used for agriculture.

Eight of the 15 benthic samples collected within the sub-watershed had WVSCI scores indicating impairment, another four were in the gray zone, and only three were unimpaired.

There were some abandoned mine lands in this sub-watershed, so it is not surprising that several streams in the area were included on the 1998 303(d) list for impairment due to mine drainage. Pecks Run and three of its tributaries, Turkey Run and one of its tributaries, and Finks Run and three of its tributaries were on the 1998 list. During this assessment period, Turkey Run was not sampled and no benthic sample was collected from Bridge Run, a tributary of Fink Run.

The data collected during this assessment did not substantiate Pecks Run's pH or metals problems as identified on the 1998 303(d) list. However, the relatively high pH (8.0), conductivity (742), and sulfate (500 mg/L) measurements may indicate the presence of treated mine drainage. The WVSCI of 71.95 indicates the benthic community at the site was unimpaired. The benthic sample was dominated by *Baetidae* mayflies and there were several other mayfly and caddisfly taxa present. Nearly 37 percent of the sub-watershed area was in agricultural usage.

The tributary, Little Pecks Run, produced some moderate metals concentrations and the manganese concentration (1.580 mg/L) violated the water quality standard for human consumption. Like the Pecks Run samples, those taken from Little Pecks Run showed evidence of the presence of treated mine drainage (e.g., conductivity = 1,268 µmhos/cm & sulfate = 670 mg/L).

Little Pecks Run was sampled near its mouth where there was no riffle/run habitat. The substrate was made up entirely of sand, silt and clay. Consequently, the MACS benthic sampling technique was used, so the WVSCI score is not comparable to riffle/run sampled sites. The "total taxa" metric value of 17 is considered moderate for streams sampled by the MACS technique, but there were no EPT taxa found. The benthic sample was collected from submerged aquatic plants and was dominated by snails and dragonfly larvae.

Mud Run, another tributary of Pecks Run included on the 1998 303(d) list for mine drainage impairment, did not appear to have persistent water quality problems due to mine drainage. The conductivity was 334 µmhos/cm and metals concentrations were not high. However, the fecal coliform bacteria concentration violated the water quality standard. The benthos at this site was not sampled in a comparable manner. Only five kick net samples were collected instead of the appropriate eight. The benthic sample was collected from sand and mud, not typical riffle/run habitat. The stream was sampled near its mouth in the middle of a hayfield. The total RBP habitat score was marginal (107).

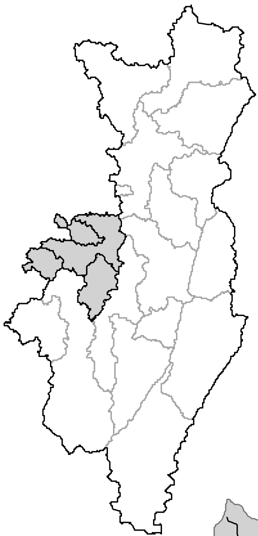
Table 11. Lower Buckhannon River sub-watershed sites including Pecks Run, Finks Run, and Sand Run watersheds				
Stream Name	ANCODE	WVSCI	RBP	Fecal
BUCKHANNON RIVER	WVMT-31-{6.6}	N/C	157	16
FIRST BIG RUN	WVMTB-1	67.11	147	104
PECKS RUN	WVMTB-5	71.95	154	16
LITTLE PECKS RUN	WVMTB-5-B	N/C	139	520
MUD RUN	WVMTB-5-C	N/C	107	488
SAND RUN	WVMTB-7-{1.0}	82.65	154	767
LAUREL FK/SAND RN	WVMTB-7-A-{0.5}	66.21	167	7280
LAUREL FK/SAND RN	WVMTB-7-A-{2.9}	67.55	129	636
UNT/SAND RUN	WVMTB-7-C-{0.32}	79.18	148	730
BIG RUN	WVMTB-8	60.65	149	2520
CHILDERS RUN	WVMTB-9	52.24	151	1684
SUGAR RUN	WVMTB-10-A	29.05	142	795
FINKS RUN	WVMTB-11	43.85	119	270
MUDLICK RUN	WVMTB-11-B	21.43	137	17
WASH RUN	WVMTB-11-B.5	28.85	118	3100
BRIDGE RUN	WVMTB-11-B.7	N/C	152	18
WVSCI scores in gray blocks indicate impairment. N/C = non-comparable.				

Sugar Run was placed on the 1998 303(d) list for impairment due to metals. During this assessment effort, the stream did not have particularly high metals concentrations. However, the sulfate concentration (690 mg/L) and conductivity (751 μmhos/cm) indicated the potential presence of treated mine drainage. The field team also noted the presence of metal hydroxides on the stream substrate. The team noted a "pipe discharging black septic ooze". The bacteria sample result (795/100 mL) violated the state water quality standard.

The benthic sample resulted in a WVSCI of 29.05, indicating impairment. The RBP habitat assessment produced a total score (142) in the suboptimal range. Of particular note is the marginal "instream cover" score of only 9. However, the greatest negative impact may have been caused by the "septic ooze" which coated the sediment at the site. Macrobenthic community metric scores support this hypothesis, with 74.31% of the organisms comprised of *Chironomidae* midges and an HBI score of 5.75.

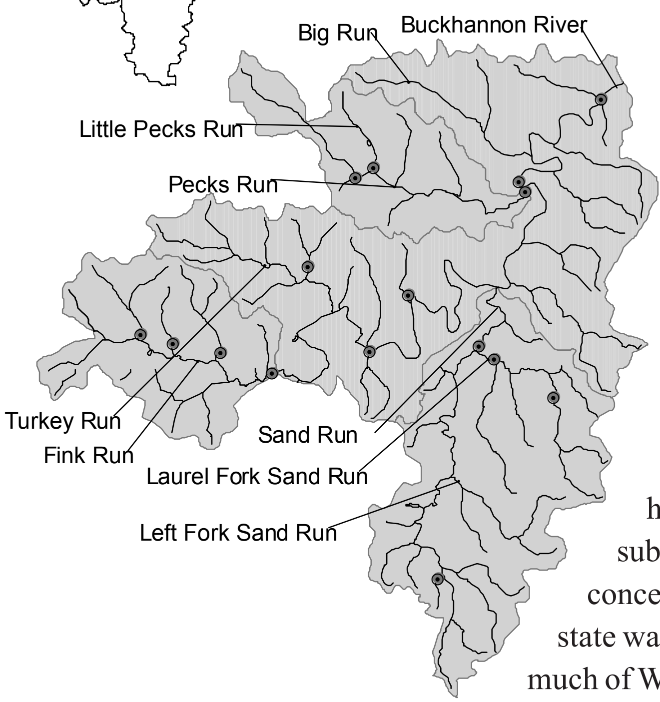
Four sites were sampled in the Fink Run sub-watershed. This sub-watershed drains the area along Route 33 west of the town of Buckhannon. Fink Run, Mud Lick Run, and Bridge Run were included on the 1998 303(d) list for impairment due to mine drainage. Wash Run was not included on the list. All four streams showed signs of impairment.

Fink Run was included on the 303(d) list as impaired by pH and metals. However, at the time of sampling and at the assessment location those parameters were not in violation of the water quality standards. On the other hand, the WVSCI score of 43.85 indicated impairment. Several characteristics typical of urbanized streams were noted by the assessment team. The total RBP habitat score (119) was within the suboptimal range, but very near the bottom. The presence of an "almost gelatinous like iron floc" and several tires and other junk in the stream were noted by the field team. In addition to these characteristics, "riffle frequency" was rated "poor". The sulfate concentration was relatively high (230 mg/L). There were several surface and deep mines within the sub-watershed. During runoff events, these mined areas may contribute contaminants to Fink Run. The stream valley



was dominated by the U.S. Rt. 33 four-lane highway, but it also hosted reclaimed surface mine land, livestock pastures, businesses, residences, and other associated roadways.

Mud Lick was identified on the 303(d) list as impaired by iron and manganese. During this assessment effort, neither of these parameters were in violation of the state water quality standards. This stream received the second lowest WVSCI score (21.43) for the entire Tygart Valley River watershed. The habitat descriptions and RBP habitat scoring were similar to those of Fink Run. Signs of urbanization were abundant. Metal hydroxides were present on the stream substrate. The field team noted the presence of a chemical odor and an oil slick. There are abandoned mine lands located within the sub-watershed (WCMS).



The benthic macroinvertebrate community of Wash Run was severely impaired (WVSCI = 28.85), so the stream should be considered for further study. Signs of urbanization were noted at the assessment site, including an oil slick on the stream's surface, a sewage odor in the water, and oil in the sediment. The total RBP habitat score was near the low end of the suboptimal range. The fecal coliform bacteria concentration (3,100/100 mL) was in violation of the state water quality standard. The WCMS illustrated that much of Wash Run's valley was covered with pasture and other grassland.

The Bridge Run sample's pH, iron, aluminum, and manganese values were all in violation of the state water quality standards. A benthic sample was not collected at this site and the reason for this omission remains unknown. The WCMS showed the lower tenth of Bridge Run's valley to be covered with urban development while the remainder was mostly covered with pasture and other grassland. Also shown was a surface mine inventory site. If an old mine exists above the sample point, it is likely the source of high net acidity (81 mg/L), high sulfate (720 mg/L), and the other problem parameters previously mentioned.

The Buckhannon River was sampled at a point 6.6 miles upstream from its mouth, just downstream from Pecks Run. The benthic sample was collected from an area with no riffle/run habitat, so the MACS sampling method was used and, therefore, the sample results are not comparable to the reference site metrics. Twelve family level taxa were collected, and most of those are considered moderately tolerant of pollution. Unfortunately, this was the only sample collected from the Buckhannon River mainstem. Consequently, Buckhannon River benthic communities could not be rated according to the WVSCI. None of the results of physicochemical analyses from this sample were in violation of state water quality standards.

First Big Run (WVMTB-1) was inadvertently sampled instead of Big Run (WVMTB-3), which had been identified on the 1996 303(d) list as impaired. Consequently, no assessment of WVMTB-3 was made. Nonetheless, WVMTB-3 was not included on the 1998 list. This deletion from the list was a mistake due to confusion over the similar names of these two streams. WVMTB-3 will be assessed in 2002. First Big Run had a WVSCI score of 67.11, placing it in the gray zone of potentially impaired streams. Nearly 40 percent of this 1,200 acre watershed was used for agricultural purposes. The RBP habitat total score was near the high end of the suboptimal range, but the "embeddedness" score was in the low end of the marginal range. Physicochemical analytical results shed no light on the reasons for the gray zone WVSCI score. Further investigation is recommended to ascertain whether or not First Big Run is impaired.

The Sand Run sub-watershed was assessed at four locations: one at the mainstem (WVMTB-7-{1.0}), two at Laurel Fork (WVMTB-7-A-{0.5} & {2.9}), and one at an unnamed tributary (WVMTB-7-C-{0.32}). The two sites on Laurel Fork produced benthic samples indicating potential impairment. The downstream site had a much higher fecal coliform bacteria concentration (7,280/100mL) than the upstream site (636/100mL). The downstream site also had profuse filamentous algae while the upstream site's periphyton/algae abundance was rated moderate. The nitrate+nitrite nitrogen concentration at the downstream site (0.41 mg/L) was almost twice as high as that at the upstream site (0.21 mg/L). These data indicate the possibility of fecal nutrient input between the two sites, but this is an uncertainty.

Although the lower Laurel Fork site received a total RBP habitat score within the optimal range, its actual potential for benthic macroinvertebrate colonization was poor due to the lack of suitable substrate. The "epifaunal substrate" parameter was rated marginal because 40% of the sampled substrate consisted of bedrock covered with filamentous algae. Only 25% consisted of cobble and the remaining 35% consisted of smaller, less stable particles (i.e., gravel, sand, & silt). Future sampling should be performed at a location with more suitable habitat.

Yet another Big Run (WVMTB-8) in this sub-watershed, a small stream draining about 530 acres, received a WVSCI score of 60.65. This score is barely above the impairment threshold of 60.6. There were only 10 taxa collected, of which only three were EPT taxa. Stressors potentially affecting the stream included agricultural land uses (almost 52 percent of the sub-watershed), a narrow intact riparian zone, and influences from residences. The high fecal coliform concentration (2,520/100 mL) was in violation of the state water quality standard.

Childers Run is another small stream (~ 1,400 acres) that drains into the Buckhannon River just northeast of Buckhannon. The WVSCI score was 52.24, indicating the site was impaired. The % EPT (17.12) and EPT taxa (6) metric values were low and chironomids made up over half of the total organisms identified (50.45%). The fecal coliform bacteria concentration was somewhat high at 1,684/100mL, a violation of the state water quality standard. There was a large hayfield adjacent to the sample site and roads ran the length of both branches of this stream. Further research will be necessary to determine the causes and sources of impairment on this stream.

Sugar Run drains a small tributary sub-watershed (~1,015 acres) of Turkey Run, with a drainage area comprised of over 37 percent agricultural land. The stream's WVSCI score (29.05) indicates severe impairment. The benthic sample was dominated by *Chironomidae* midges and *Hydropsychidae* caddisflies (over 87 % of the individuals). There were several areas in the watershed identified as abandoned mine lands and their presence was made apparent by the high sulfate concentration at this site (690 mg/L). Mining site discharges into Sugar Run upstream of the sampling site, may have been treated, but this is an uncertainty. Other potential stressors included agriculture and roads that ran the length of both branches of the stream above the sample point. The bacteria concentration (795/100 mL) was in violation of the state water quality standard.

Sites that had both (1) WVSCI scores indicating unimpaired benthic macroinvertebrate communities and (2) bacteria concentrations above the state standard are the unnamed tributary of Sand Run and Sand Run.

Leading Creek Sub-watershed

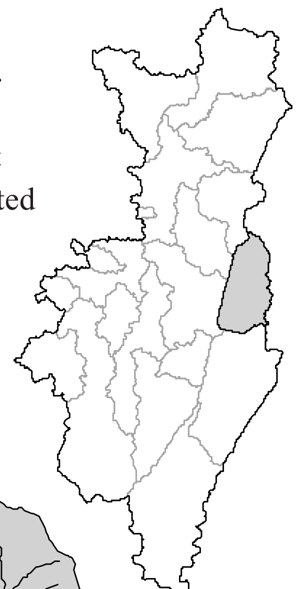
The Leading Creek sub-watershed drains the east slope of Laurel Mountain, the west slope of Cheat Mountain, and the wide valley between. The valley drains through alluvial soils and is extensively used for agricultural purposes. The mountain slopes are forested. Seven sites were sampled within this sub-watershed and their benthos indicated a wide range of biological health. Three sites were impaired, three were unimpaired, and one was potentially impaired. No streams in this watershed were listed on previous 303(d) lists.

There were two sites sampled on the mainstem of Leading Creek (WVMT-43-{13.2} & {15.6}). The downstream benthic sample at milepoint 13.2, had a WVSCI score (64.95) within the gray zone. The other sample had a WVSCI score of 75.83 and therefore, was considered unimpaired.

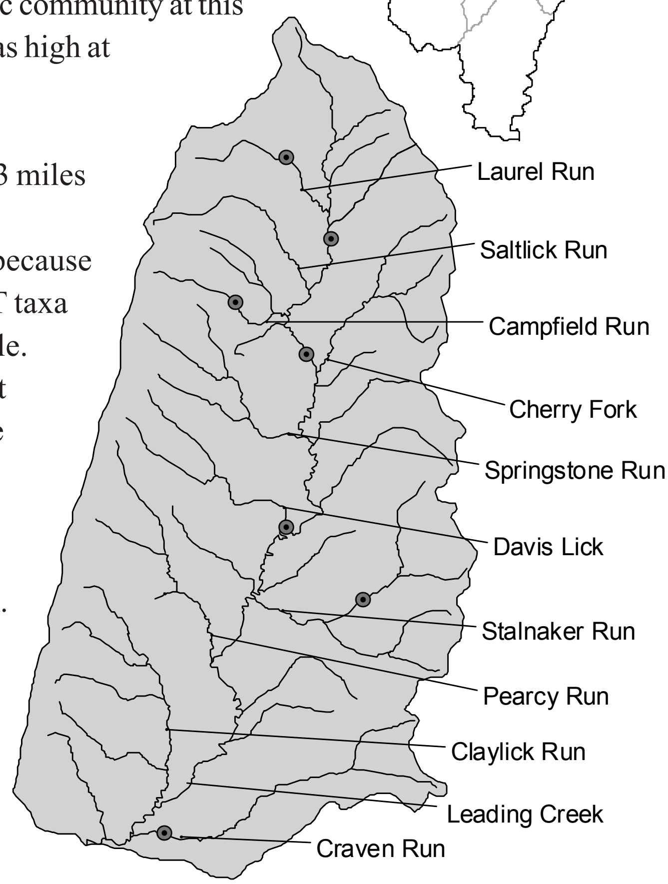
The downstream site had no obvious water quality problems at the time of sampling. The total RBP habitat score (178) was within the optimal range, and the substrate where the benthic sample was

Table 12. Leading Creek sub-watershed sites				
Stream Name	ANCODE	WVSCI	RBP	Fecal
LEADING CREEK	WVMT-43-{13.2}	64.95	178	232
LEADING CREEK	WVMT-43-{15.6}	75.83	149	1535
LOGLICK RUN	WVMT-43-F-1	88.13	162	60
DAVIS LICK	WVMT-43-H	36.47	106	3800
CAMPFIELD RUN	WVMT-43-M	83.67	150	258
LAUREL RUN	WVMT-43-O	56.56	125	171
CRAVEN RUN	WVMT-43-A	45.58	101	1757
Sites in gray blocks have WVSCI scores indicative of impairment				

collected consisted mainly of cobble. There were four mayfly families, one caddisfly family, and no stoneflies. This sample scored low primarily because of low EPT numbers (5 taxa). Most unimpaired streams have double this number or more EPT taxa. Even though the upstream site produced an unimpaired benthic sample, it also produced a bacteria concentration (1,535/100mL) in violation of the state water quality standard.



The Davis Lick benthic macroinvertebrate sample produced the lowest WVSCI score in the Leading Creek watershed. The site's substrate consisted almost entirely of clay with small amounts of woody debris. The stream flowed through agricultural lands for several miles upstream of the sampling point. There was no riffle habitat, only shallow pools and runs. Indeed, the glide/pool RBP habitat assessment form was utilized by the sampling team, instead of the riffle/run form. It is highly likely that poor habitat was the primary cause of impairment of the benthic community at this site. The fecal coliform bacteria concentration was high at 3,800/100mL.



Laurel Run (WVMT-43-O) was sampled 1.3 miles upstream from its mouth. Its benthic sample was impaired. The WVSCI score was low primarily because of the two EPT metrics. There were only six EPT taxa and they formed less than 40 percent of the sample. The assessment team reported heavy sand and silt deposits. The substrate where the benthic sample was collected had only 15 percent cobble, the remaining substrate consisted of gravel, sand, silt, and clay. The riparian zone was compromised having hayfields within a few meters of the stream.

Craven Run was sampled within the city limits of Elkins. The WVSCI score (45.58) indicates impairment and the total RBP habitat score (101) is the lowest of any site sampled within the Tygart Valley River watershed.

"Embeddedness," "sediment deposition," and "riparian vegetation zone width" parameters all scored in the poor range. The site had been channelized and there was a lot of clay, brick, block, and other junk in the stream bed. The bacteria concentration (1,757/mL) was in violation of the water quality standards.

Lower Mid Tygart Valley River Sub-watershed - Including Teter Creek and Laurel Creek Sites

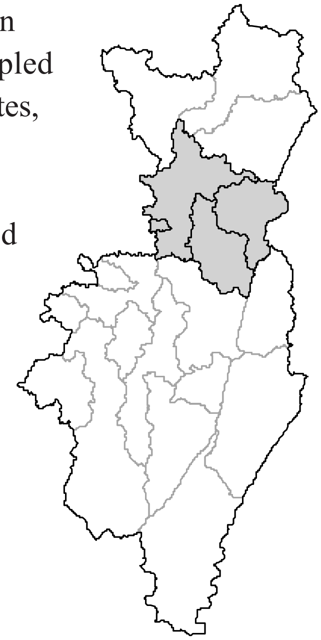
This section of the watershed covers the area downstream of Buckhannon River to below the downstream end of Tygart Lake at the mouth of Three Fork Creek. The drainage areas of Teter Creek and Laurel Creek comprise about 55 percent of this sub-watershed's total area.

There were 16 sites sampled in this sub-watershed. Six of these produced benthic macroinvertebrate samples with WVSCI scores indicating impairment, but only three of the samples are considered comparable by the WVSCI procedure.

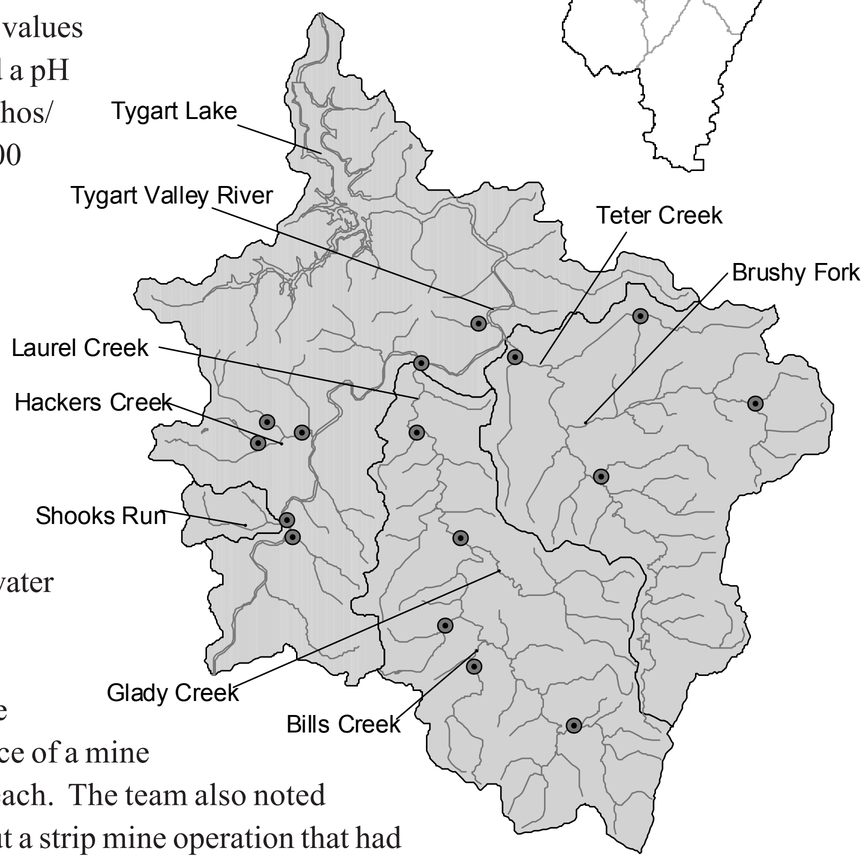
Five streams were included on the 1998 303(d) list for impairment due to mine drainage. Four of the five were sampled during this assessment effort. Ford Run was not sampled. Two of the four sampled 303(d) streams (Foxgrape Run & Little Hackers Creek) were sampled using the noncomparable MACS technique. The other two 303(d) streams (Anglins Creek & Frost Run) had impaired benthic communities.

Frost Run was placed on the 303(d) list, with pH and metals identified as the pollutants. During this assessment, the only water quality constituent in Frost Run that showed a violation of the water quality standards was manganese, with a concentration of 1.100 mg/L. The WCMS showed the presence of mining activities within the Frost Run sub-watershed. The abandoned mines in this area may be the sources of the relatively high concentration of manganese measured at this site. This site's total RBP habitat score was within the suboptimal range. Other than the marginal score for "epifaunal substrate" the assessment team turned up no clear clues to the reasons for the relatively low WVSCI score (47.04). The benthic sample was dominated by *Hydropsychidae* caddisflies and *Chironomidae* midges, together comprising almost 89 percent of all organisms identified.

Metals and pH also were the pollutants identified on the 303(d) entry for Anglins Run. Even though the WCMS showed mining activity within this sub-watershed area, no violations of water quality standards for these parameters were found in Anglins Run during this assessment effort. However, the bacteria sample (> 6,000/100mL) was in violation of the standard. Anglins Run was sampled near the city limits of Phillipi. There was a fair amount of residential development extending from town along the stream above the sample site. U.S. Rt. 250 ran along the entire length of the left fork of the stream. The high bacteria levels can almost certainly be attributed to domestic sources (e.g., inadequate sewage treatment) since there was very little agriculture in the watershed. There was a high abundance of algae at the site. The sampled substrate was not suitable for full colonization by benthic macroinvertebrates, with no particles larger than gravel size found there.



Foxgrape Run and Little Hackers Creek were listed as being impaired by metals. Aluminum, iron, and manganese levels were fairly low for both of these streams. However, each of the site's pH, conductivity, and sulfate concentration were relatively high. These streams may have been receiving mine drainage treated with alkaline substances. This would explain the high values for the nonmetals parameters and the low values for the metals. Foxgrape Run had a pH of 8.1, a conductivity of 4,000 µmhos/cm, a sulfate concentration of 2,300 mg/L, and an alkalinity of 160 mg/L. Little Hackers Creek's values for the same constituents were, respectively, 8.09, 2,040 µmhos/cm, 710 mg/L, and 230 mg/L. The WCMS showed mining activities in both of these sub-watershed areas. Both sites also produced bacteria concentrations in violation of the water quality standard.



For Little Hackers Creek, the assessment team noted the presence of a mine sludge pond above the sampled reach. The team also noted that a landowner complained about a strip mine operation that had not been reclaimed. At the Little Hackers Creek site, there was no riffle/run habitat, so the benthos were collected using the noncomparable MACS methodology. There were 21 family level taxa identified from this sample. Only two other sites in the Tygart Valley watershed had more. However, many of these taxa were snails, dragonflies, and damselflies, indicative of ponded water. This site also had poor riparian habitat, with no trees or shrubs along the entire length of the assessed reach.

For Foxgrape Run, the team noted there was very little habitat suitable for the benthic collection, so the area sampled was only one square meter instead of the two required for the sample to be

Table 13. Lower Mid Tygart Valley River sub-watershed sites including Teter Creek and Laurel Creek watersheds				
Stream Name	ANCODE	WVSCI	RBP	Fecal
TYGART VALLEY RIVER	WVM-27-{46.2}	74.59	135	360
CUNNINGHAM RUN	WVMT-22	77.93	151	117
TETER CREEK	WVMT-23	80.45	180	217
STONY RN / RACOON CK	WVMT-23-B-1	63.22	141	700
BRUSHY FORK	WVMT-23-C-{5.6}	81.51	171	240
MILL RN / TETER CK	WVMT-23-F	74.54	158	92
LAUREL CREEK	WVMT-24-{0.03}	76.49	183	258
FROST RUN	WVMT-24-A	47.04	134	268
SUGAR CREEK	WVMT-24-C	71.25	131	35
BEAR RUN	WVMT-24-C-1.5-A	N/C	116	8
BILLS CREEK	WVMT-24-C-2	61.14	115	185
HUNTER FORK	WVMT-24-C-3.5	68.63	147	1288
HACKERS CREEK	WVMT-26-{0.4}	54.41	132	500
FOXGRAPE RUN	WVMT-26-B	N/C	120	632
LITTLE HACKERS CK	WVMT-26-C	N/C	105	1200
ANGLINS RUN	WVMT-29	45.70	128	6000
WVSCI scores in gray blocks indicate impairment. N/C = non-comparable.				

considered comparable.

The Hackers Creek site is downstream of Foxgrape Run and Little Hackers Creek, and therefore suffered from similar poor quality water during this assessment. Conductivity was 2,610 µmhos/cm and sulfate concentration was 1000 mg/L. The WCMS indicated that mining activity was located in the headwater region of Hackers Creek. There was a pasture adjacent to the stream and cattle had access to the stream. The bacteria concentration was in violation of the state water quality standard. The benthic sample was dominated by *Hydropsychidae* caddisflies and *Chironomidae* midges. Over 75 percent of the organisms collected were from these families.

Four locations were sampled within the Teter Creek sub-watershed. All but one had WVSCI scores indicating unimpaired benthic communities. Stony Run of Raccoon Creek had a WVSCI score indicating potential impairment. Over 50 percent of its watershed area was in agricultural usage. The Stony Run site had the lowest total RBP habitat score and the highest fecal coliform bacteria concentration of the sites sampled in the Teter Creek sub-watershed. The RBP score was within the suboptimal range. Further study is necessary to determine whether or not this site should be considered impaired.

The Laurel Creek sub-watershed was sampled at six locations. The benthic macroinvertebrate sample at one site was collected via the noncomparable MACS technique. One site sampled by the comparable riffle/run kick technique produced a WVSCI score indicating impairment and another had a score indicating potential impairment.

Bear Run lacked stable riffle/run substrate so that the benthic sample could not be collected using the kick net protocol. Bear Run is a very small stream draining approximately only a 280 acre watershed area. Overhanging vegetation and woody snags were sampled via the MACS methodology. The substrate at this site was entirely sand and silt and the stream was dry in parts of the 100 meter assessment reach and probably at least partially dry during most of the late summer and early fall dry season. Land uses within the watershed included reclaimed surface mines utilized for pasturage (WCMS). Although only 12 organisms were collected in the benthic sample, they represented 10 family level taxa, including several dragonflies and damselflies typical of ponded habitat.

Bills Run was sampled at the intersection of CR 9, 0.9 miles upstream of its mouth. The site's WVSCI score was within the gray zone of possible impairment. Possible stressors included a low dissolved oxygen concentration (4.9 mg/L), a marginal "epifaunal substrate" score, and a compromised riparian buffer zone. There was also a fair amount of agricultural land usage in the watershed as well as a small amount of abandoned surface mine acreage. Further research will be necessary to determine the true condition of this stream's benthological community.

Frost Run, the only comparably-sampled stream within the Teter Creek sub-watershed found to be impaired, was discussed previously.

Lower Tygart Valley River sub-watershed - Including Three Fork Creek and Sandy Creek Sites

This sub-watershed group includes Sandy Creek and those streams that drain into Tygart Valley River downstream of Tygart Lake. Within this area is the town of Grafton and the southern portion of the city of Fairmont. Sections of this sub-watershed have been heavily mined, especially in the headwaters of Three Fork Creek, Berkeley Run, and Little Cove Run and Left Fork of Sandy Creek.

This sub-watershed group had 18 streams included on the 1998 303(d) list. These streams were identified as being impaired by either pH/metals or metals alone. Nine of these streams were sampled as part of this assessment. Five 303(d) streams in the Three Fork Creek sub-watershed and four in the Sandy Creek sub-watershed were not sampled during this assessment effort. Eight of the nine 303(d) listed streams that were sampled as part of this assessment effort produced benthic macroinvertebrate samples suggesting impairment to the benthic communities. One site produced a WVSCI score in the gray zone. These streams will be discussed along with the other impaired streams in this sub-watershed.

Goose Creek was included on the 1998 303(d) list as being impaired by pH and metals. During this assessment effort, the aluminum concentration (1,200 mg/L) was in violation of the state water quality standard. Conductivity (918 µmhos/cm) and sulfate concentration (430 mg/L) were also relatively high, but pH was within the acceptable range of the state water quality standards. The instream habitat was good for benthic colonization, except for a marginal score for "embeddedness" and the presence of precipitates of aluminum and iron. Minimal embeddedness is necessary for providing living space for most stream-dwelling benthic macroinvertebrates. These data indicated the likely presence of treated mine drainage at the site and indeed, located nearby was an AMD treatment facility of the Tygart Valley mine.

There were only three benthic organisms in the entire Goose Creek sample, two *Hydropsychidae* caddisflies and one *Elmidae* beetle. The WVSCI score is within the impaired range, but is considered relatively high considering the sample had only three organisms. This surprisingly moderate score within the impaired range is due to the sample's scoring fairly high for % EPT, HBI, and % Chironomids. Several other higher than expected scores for low-organism samples in numerous watersheds throughout the state have caused the Section to consider altering its use of the WVSCI in such situations. The Section is currently developing a policy of applying the WVSCI procedure only to those samples that produce a certain minimum number of organisms or higher.

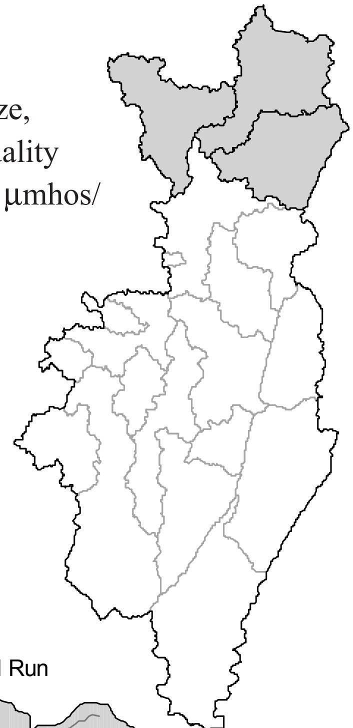
Plum Run had a WVSCI score just 0.21 points below the unimpaired range. The water quality of this gray zone stream identified no obvious causes of impairment on the sampling date. The total RBP habitat score was within the optimal range. This stream should be assessed more thoroughly to determine its impairment status, and potential causes and sources of impairment.

Wickwire Run was sampled about 0.4 miles from its mouth. The water quality did not reveal any problems. The WVSCI score was depressed primarily because of low scores for the % EPT and EPT taxa metrics. There were no clear reasons for impairment identified by either the assessment team or the water quality analyses. Further sampling is warranted.

Berkeley Run and three of its tributaries were sampled as part of the assessment. All four sites were included on the 1998 303(d) list of mine drainage impaired streams. One of the sites, Berry Run, was sampled benthically using the MACS technique, and was therefore, considered noncomparable. All three kick-sampled sites produced WVSCI scores indicating impairment or potential impairment to the benthic macroinvertebrate communities. There has been extensive mining in this watershed and the water quality indicates this, with higher than natural conductivities and elevated metals concentrations.

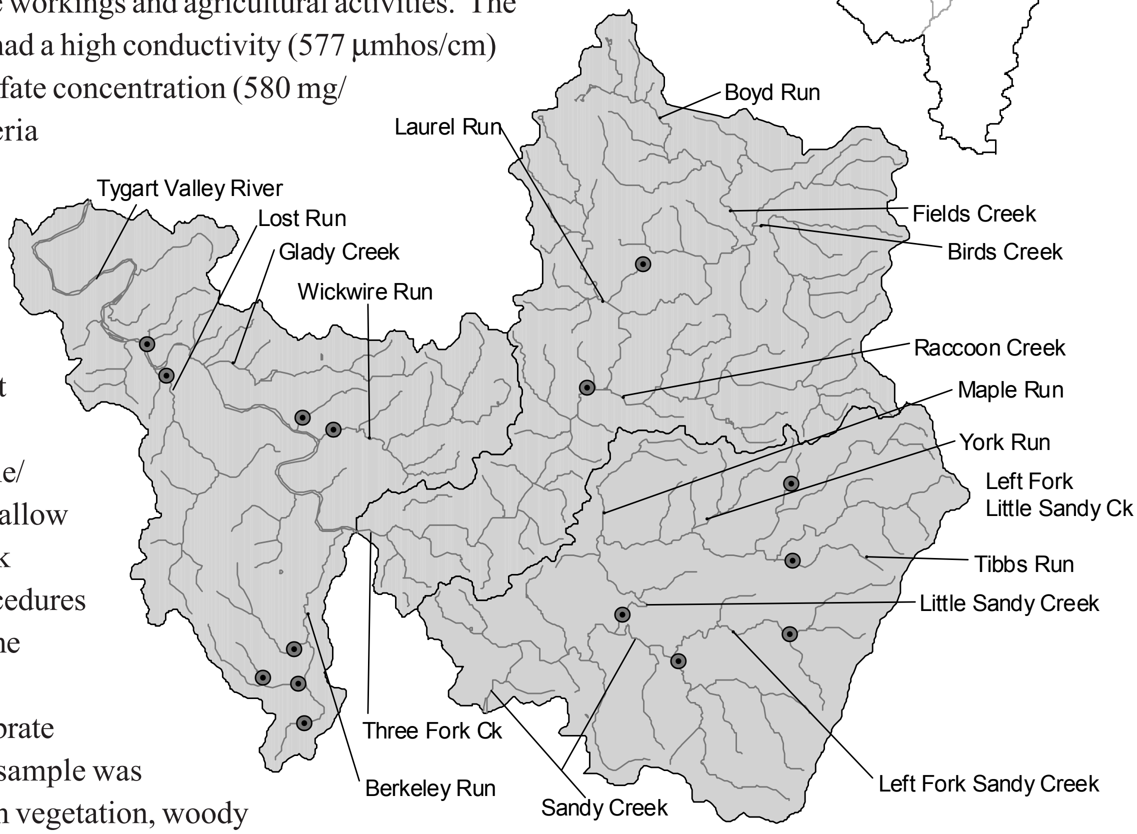
Berkeley Run was sampled near its headwaters, 6.6 miles from its mouth. The water at this site had no metals concentrations above the state water quality standards. However, the fecal coliform bacteria concentration exceeded the standard. The land above the sample was mostly pasture and the high fecal value may have been associated with livestock. There does not appear to have been any mining this far up the watershed. Consequently, with no sample from a site downstream of mining activities, these data can neither support nor refute Berkeley Run's inclusion on the 303(d) list.

Shelby Run, a 303(d) list stream, had an impaired benthic community (WVSCI = 59.95). The stream also had a high conductivity (666 µmhos/cm) and sulfate concentration (320 mg/L), but its metals concentrations were below state water quality standards. The fecal coliform bacteria concentration exceeded the standard. There were extensive abandoned mines in the headwater area of this watershed and metal precipitates were reported on the substrate. Not quite half of the land area was utilized for pasture and hay production.



Another 303(d) list stream, Long Run, was similar to Shelby Run in size, land usage, and impaired benthic community status. However, the water quality was worse at this site during the assessment period. The conductivity (974 µmhos/cm) was higher and the metal concentrations were higher, although none exceeded the water quality standards. The total RBP habitat score was in the marginal range. The substrate where the benthic sample was collected consisted of 85 percent gravel or smaller particles and the larger particles were over 75 % surrounded by sand and/or silt.

Berry Run (WVMT-11-B-1), another 303(d) list stream, is a small tributary of Long Run. This stream showed signs of stress from old mine workings and agricultural activities. The sampled site had a high conductivity (577 µmhos/cm) and a high sulfate concentration (580 mg/L). The bacteria concentration exceeded the state water quality standard. There was not an adequate amount of riffle/run habitat to allow the use of kick sampling procedures in collecting the benthic macroinvertebrate sample. The sample was collected from vegetation, woody debris, and a small section of faster water over gravel/sand using the MACS methodology. The sample produced 20 distinct family level taxa, but only four were of the more sensitive EPT groups.



The Three Fork Creek sub-watershed is fairly large with a drainage of over 64,000 acres. There were strip and deep mines throughout large portions of this watershed. Six streams in this sub-watershed were included on the 1998 303(d) list, including the mainstem. These streams were considered impaired by metals and/or pH problems. Only one of these streams, the mainstem, was sampled as part of this assessment. The site sampled was 10 miles upstream from the mouth and about a half mile downstream of the confluence of Raccoon Creek and Three Fork Creek. The water quality was poor. The pH was 4.3, aluminum was 7.3 mg/L, and manganese was 2.1 mg/L. The instream and streamside habitats appeared to be in relatively good condition, since the site had a total RBP habitat score within the optimal range. The substrate was 70 percent cobble and boulder. The site is represented in Figure 9a as the point (labeled 53) closest to the lower right corner. Generally, sites that plot on the lower right quadrant of the habitat vs. WVSCI graph are water quality limited, i.e. they have habitat capable of supporting a healthy benthic macroinvertebrate community, but poor water quality prevents the community from approaching its potential. Only 12 organisms were collected from the two square meter collection area. More sampling should be done in this watershed to determine the extent of mine drainage impacts.

Table 14. Lower Tygart Valley sub-watershed sites including Three Fork Creek and Sandy Creek sites

Stream Name	ANCODE	WVSCI	RBP	Fecal
GOOSE CREEK	WVMT-4	44.15	157	10
LOST RUN	WVMT-5	76.75	205	100
PLUM RUN	WVMT-7	67.79	166	91
WICKWIRE RUN	WVMT-8	59.38	173	60
BERKELEY RUN	WVMT-11-{6.6}	61.39	135	6000
SHELBY RUN	WVMT-11-A	59.95	113	6000
LONG RUN	WVMT-11-B	53.18	108	950
BERRY RUN	WVMT-11-B-1	N/C	106	520
THREE FORK CREEK	WVMT-12-{10.2}	37.01	168	0
SANDY CREEK	WVMT-18-{9.6}	36.08	118	1250
LITTLE SANDY CREEK	WVMT-18-E-{0.4}	N/C	144	< 2
UNT / LEFT FK / L. SANDY CK	WVMT-18-E-3-A-{1.2}	80.15	155	1683
TIBBS RUN	WVMT-18-E-4-A	71.08	154	1045
UNT / LEFT FK / SANDY CK	WVMT-18-G-2	71.81	146	630
WVSCI scores in gray blocks indicate impairment. N/C = non-comparable.				

The Sandy Creek sub-watershed drains over 57,000 acres and empties directly into Tygart Lake. Swamp Run and Little Cove Run sub-watersheds, as well as the central parts of the Sandy Creek sub-watershed had large percentages of land in agricultural use. Mining activities were present in several of the headwater drainage areas. The sub-watershed had six streams on the 1998 303(d) list, two of which were sampled as part of this assessment. The two streams, Sandy Creek and Little Sandy Creek, had impaired benthic communities. Three smaller streams not included on the 303(d) list were sampled as well and found supporting unimpaired benthic communities.

The site on Sandy Creek is upstream of its confluence with Left Fork and almost 10 miles upstream from Tygart Lake. The water quality appeared to be unimpaired, but the habitat was likely limiting the benthic macroinvertebrate colonization potential. The substrate where the benthic sample was collected consisted of 90% gravel or smaller particles and the larger particles were over 75% embedded with sand and/or silt. The total RBP habitat score was within the suboptimal range, but it may have been recorded lower than it actually was, due to the assessment team's apparent confusion.

The team entered conflicting information on the assessment form. Eight riffle/run kick samples were collected and both the average riffle depth and the average run depth were recorded as 0.1 meter. However, the recorder also indicated on the RBP habitat assessment that shallow habitats less than 0.5 meters were entirely missing. Black fly larvae (*Simuliidae*) and midges (*Chironomidae*) comprised over 86 percent of the total number of organisms collected. Because there was only one site sampled on this 13 mile long stream, that site should not be used to extrapolate a judgement of impairment status over the entire stream. The sample site had very little riffle/run habitat, yet only a few miles in either direction, where the stream's gradient is much steeper, such habitat was abundant. Sandy Creek should be sampled at several locations to determine the extent of mine drainage impacts. The available data indicate that upstream of Little Sandy Creek, the mainstem may not have been negatively impacted by mine drainage.

Little Sandy Creek was sampled less than half a mile from its mouth, near the point where Preston, Taylor, and Barbour counties meet. The pH was 3.5 and the net acidity was 89 mg/L on the day of sampling. This site had the highest concentration of aluminum measured in the entire Tygart Valley River watershed (10.0 mg/L). The iron concentration was also in violation of the state water quality standard. These data indicate this stream should remain on the 303(d) list. There was no riffle/run habitat, therefore the benthos were collected from woody snags and submerged aquatic plants. None of the organisms collected were from the EPT orders (i.e., orders considered somewhat sensitive to pollution).

Summary of Results

The Tygart Valley River watershed was sampled in August and September of 1997. A total of 132 sites on 124 streams were sampled. Benthic macroinvertebrate samples were collected at 129 of the sites and 114 of these are considered comparable to the Section's set of reference sites. Of the 114 comparable benthic samples, 66 had unimpaired benthic communities, 32 were impaired, and the remaining 16 received WVSCI scores indicating potential impairment.

Many of the sites that received low scores for the benthic communities were impaired by the affects of coal mining. Some of these sites did not produce acidic water, but they had elevated sulfate and metals concentrations. Some streams had more typical mine drainage problems with associated low pH values. Tables 15 and 16 list the sites impaired by mine drainage. Those with an asterisk beside their names had TMDL's developed for them in 1998 or 2001.

Table 15. Sites impacted by non-acidic mine drainage	
Stream name	AN Code
Sawmill Run	WVMTB-20
Blacklick Run *	WVMTB-18-B-2
Bull Run *	WVMTB-18-B
Sugar Run *	WVMTB-10-A
Fink Run *	WVMTB-11
Little Pecks Run *	WVMTB-5-B
Foxgrape Run *	WVMT-26-B
Little Hackers Ck *	WVMT-26-C
Hackers Creek	WVMT-26
Shelby Run *	WVMT-11-A
Long Run *	WVMT-11-B

Table 16. Sites impacted by acid mine drainage	
Stream name	AN Code
Roaring Creek *	WVMT-42
UNT/Flatbush Fork	WVMT-42-B-1
Island Run *	WVMT-36
Beaver Creek (lower) *	WVMT-37
Swamp Run *	WVMTB-29
Bridge Run *	WVMTB-11-B.7
Threefork Creek *	WVMT-12
Little Sandy Creek *	WVMT-18-B
Grassy Creek *	WVMT-41
Tenmile Creek*	WVMTB-25

There were 18 streams in the Tygart Valley River watershed included on the 1998 303(d) list as impaired by acid rain. Thirteen of these streams were sampled as part of this assessment. Of these, only five produced low pH measurements at the time of sampling. This does not imply that the other nine streams were not impacted by acid precipitation--they may well have been impacted during wetter periods than the sampling season, such as during spring runoff or winter snowmelt events.

Table 17. Sites potentially impacted by acid rain			
Stream name	AN Code	pH	Cond. (μ mhos/cm)
Potatohole Fork	WVMT-42	4.60	15
Meatbox Run	WVMT-64-E	4.70	15
Phillips Camp Run	WVMTB-32-I-1	5.10	28
Service Run	WVMTM5	4.80	33
Short Run	WVMTM7	5.80	35

A few sites appeared to be impacted by excessive nutrients. These streams had low benthic scores and some signs of eutrophication.

Table 18. Sites potentially impacted by nutrients

Stream name	AN Code
Rifle Creek	WVMT-66
McGee Run	WVMT-66-B
Poundmill Run	WVMT-69
Laurel Run	WVMTB-24
Mudlick Run	WVMTB-18-B-3

There were several sites with impaired benthic communities that could be attributed (at least in part) to poor habitat. The following sites had low total RBP habitat scores and impaired benthic macroinvertebrate communities.

Table 19. Sites with limited habitat

Stream name	AN Code	Habitat Score	WVSCI
Long Run	WVMT-11-B	108	53.18
Roaring Creek	WVMT-42-(7.7)	108	44.08
Craven Run	WVMT-43-A	101	45.58
Davis Lick	WVMT-43-H	106	36.47
McGee Run	WVMT-66-B	105	31.23
Mud Run	WVMTB-5-C	107	43.06
Little Hacker s Creek	WVMT-26-C	105	53.40
Bear Run	WVMT-24-G1.5-A	116	57.62

Several sites had high fecal coliform bacteria levels at the time of sampling. The following 10 sites produced bacteria concentrations greater than 2000 colonies/100mL.

Table 20. Sites with high fecal coliform bacteria

Stream name	AN Code	Bacteria
Berkeley Run	WVMT-11-(6.6)	6,000
Shelby Run	WVMT-11-A	6,000
Anglins Run	WVMT-29	6,000
Shooks Run	WVMT-35.5	3,200
Davis Lick	WVMT-43-H	3,800
McGee Run	WVMT-66-B	2,540
Foundmill Run	WVMT-69	5,655
Welsh Run	WVMTB-11-B.5	3,100
Laurel Fork/Sand Run	WVMTB-7-A-(0.5)	7,280
Big Run	WVMTB-8	2,520

The following six streams met all of the Section's reference site criteria and are currently being used in the reference set, to which all other streams are compared when determining benthological impairments. These were the least impacted streams found in the Tygart Valley River watershed during the time of sampling. These streams should be granted rigorous protection so that the agency remains able to accurately assess the benthological health of streams within the state.

Table 21. Reference site streams

Stream name	AN Code
Mill Creek	WVMT-64-(6.7)
Hanging Run	WVMTM-1
Right Fork/Middle Fork	WVMTM-11-(7.6)
Jenks Run	WVMTM-11-E
Schoolcraft Run	WVMTM-25-(1.5)
Birch Fork	WVMTM-25-A

In addition to these six reference sites, there were 27 other sites (see Table 22 on the following page) that had benthic macroinvertebrate communities similar to the reference sites (i.e., WVSCI scores greater than the 25th percentile of the reference sites range).

Higher than expected scores for low-organism samples in numerous watersheds throughout the state have caused the Section to consider altering its use of the WVSCI in such situations. The Section is currently developing a policy of applying the WVSCI procedure only to those samples that produce a total number of organisms greater than a certain minimum.

Additional Resources

The watershed movement in West Virginia involves a wide variety of federal, state, and non-governmental organizations that are available to help improve the health of streams in this watershed. Several agencies established the West Virginia Watershed Management Framework. A Basin Coordinator coordinates the activities of these agencies. The Basin Coordinator may be contacted at (304)-558-2108. In addition to this citizen assistant, the DEP's Stream Partners Program coordinator, available at (800)-556-8181, serves as a clearinghouse manager for various watershed related resources.

Table 22. Other high quality sites		
Stream name	A-N Code	WVSCI
Stewart Run	WVMT-75-(16.2)	95.26
Windy Run	WVMT-79-(0.9)	92.02
Glade Run/Mill Creek	WVMT-64-C	89.16
Loglick Run	WVMT-43-F-1	88.13
Fortlick Run	WVMT-74-B-1	86.77
Laurel Run	WVMTM-2	85.65
Big Run	WVMT-81-(0.8)	85.12
Elkwater Fork	WVMT-74	84.69
Limekiln Run	WVMT-50-A-1	84.27
Campfield Run	WVMT-43-M	83.67
Hill Run	WVMT-50-B-3	83.30
Sand Run	WVMTB-7-(1.0)	82.65
Upper Trout Run	WVMTB-31-F-2-(0.8)	82.35
Files Creek	WVMT-50	82.35
Brushy Fork	WVMT-23-C-(5.6)	81.51
Teter Creek	WVMT-23	80.45
UNT/Left Fork/ Little Sandy Creek	WVMT-18-E-3-A-(1.2)	80.15
Salt Block Run	WVMTB-31-F-5	80.06
Becky Creek	WVMT-68	79.80
Short Run	WVMTM-7	79.80
Meatbox Run	WVMT-64-E	79.69
Phillips Camp Run	WVMTB-32-I-1	79.20
UNT/Sand Run	WVMTB-7-C-(0.32)	79.18
Laurel Fork/French Creek	WVMTB-18-D-(3.9)	78.62
Potatohole Fork	WVMT-64-F	78.54
Long Run	WVMTM-13-(0.8)	78.30
Jones Run	WVMT-57-(0.4)	78.18

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Appendix A. Data Tables

Table A-1. Sites Sampled

Stream Name	Stream Code	Date	Latitude			Longitude			County
TYGART VALLEY RIVER	WVM-27-{115.0}	9/ 3/97	38	41	46.35	79	59	4.66	Randolph
TYGART VALLEY RIVER	WVM-27-{46.2}	9/11/97	39	9	9	80	2	30	Barbour
TYGART VALLEY RIVER	WVM-27-{83.0}	8/27/97	38	55	10	79	51	43.15	Randolph
TYGART VALLEY RIVER	WVM-27-{93.6}	8/27/97	38	53	2.91	79	52	36.95	Randolph
GOOSE CREEK	WVMT-4	8/25/97	39	24	35	80	7	36	Marion
LOST RUN	WVMT-5	8/25/97	39	23	52	80	7	2	Taylor
PLUM RUN	WVMT-7	8/26/97	39	22	53.6	80	2	58.27	Taylor
WICKWIRE RUN	WVMT-8	8/26/97	39	22	36.22	80	2	5.03	Taylor
BERKELY RUN	WVMT-11-{6.6}	8/27/97	39	16	0.16	80	3	1.31	Taylor
SHELBY RUN	WVMT-11-A	8/26/97	39	17	39.21	80	3	19.6	Taylor
LONG RUN	WVMT-11-B	8/26/97	39	16	53.19	80	3	12.75	Taylor
BERRY RUN	WVMT-11-B-1	8/26/97	39	17	0.56	80	4	13.67	Taylor
THREE FORK CREEK	WVMT-12-{10.2}	9/ 2/97	39	23	29.17	79	54	29.52	Taylor
SANDY CREEK	WVMT-18-{9.6}	9/ 3/97	39	17	17.21	79	51	53.39	Preston
LITTLE SANDY CREEK	WVMT-18-E-{0.4}	9/ 4/97	39	18	20.99	79	53	32.42	Preston
UNT/LEFT FORK/LITTLE SANDY	WVMT-18-E-3-A-{1.2}	9/ 3/97	39	21	14.46	79	48	27.21	Preston
TIBBS RUN	WVMT-18-E-4-A	9/ 3/97	39	19	31.56	79	48	26.4	Preston
UNT/LEFT FORK/SANDY CREEK	WVMT-18-G-2	9/ 3/97	39	17	52.76	79	48	32.84	Preston
CUNNINGHAM RUN	WVMT-22	9/ 9/97	39	13	25	79	57	1	Barbour
TETER CREEK	WVMT-23	9/ 9/97	39	12	41.19	79	56	0.86	Barbour
STONY RUN/RACOON	WVMT-23-B-1	9/ 4/97	39	13	31.75	79	52	28	Barbour
BRUSHY FORK	WVMT-23-C-{5.6}	9/ 4/97	39	11	34.77	79	49	15.17	Tucker
MILL RUN/TETER CREEK	WVMT-23-F	9/ 9/97	39	10	2.28	79	53	38.02	Barbour
LAUREL CREEK	WVMT-24-{0.03}	9/10/97	39	12	34	79	58	40	Barbour
FROST RUN	WVMT-24-A	9/10/97	39	11	1.21	79	58	48.56	Barbour
SUGAR CREEK	WVMT-24-C	9/ 9/97	39	8	41.58	79	57	36.13	Barbour
BEAR RUN	WVMT-24-C-1.5-A	9/10/97	39	6	45.43	79	58	4.67	Barbour
BILLS CREEK	WVMT-24-C-2	9/10/97	39	5	52.14	79	57	17.01	Barbour
HUNTER FORK	WVMT-24-C-3.5	9/10/97	39	4	33.5	79	54	28	Barbour
HACKERS CREEK	WVMT-26-{0.4}	8/27/97	39	11	4.43	80	2	2.31	Barbour
FOXGRAPE RUN	WVMT-26-B	9/16/97	39	11	18	80	3	3	Barbour
LITTLE HACKERS CREEK	WVMT-26-C	8/27/97	39	10	51	80	3	19	Barbour
ANGLINS RUN	WVMT-29	9/11/97	39	8	46.08	80	2	20.71	Barbour
BUCKHANNON RIVER	WVMT-31-{6.6}	9/16/97	39	3	45.69	80	7	25.51	Barbour
FIRST BIG RUN	WVMTB-1	9/17/97	39	5	26.5	80	5	14	Barbour
PECKS RUN	WVMTB-5	9/16/97	39	3	34	80	7	15	Barbour
LITTLE PECKS RUN	WVMTB-5-B	9/17/97	39	4	5.8	80	11	13.6	Upshur
MUD RUN	WVMTB-5-C	9/ 2/97	39	3	53	80	11	41	Upshur
SAND RUN	WVMTB-7-{1.0}	9/ 3/97	39	0	25	80	8	30	Upshur
LAUREL FORK/SAND RUN	WVMTB-7-A-{0.5}	9/ 3/97	39	0	9.41	80	8	4.99	Upshur
LAUREL FORK/SAND RUN	WVMTB-7-A-{2.9}	9/ 3/97	38	59	20.5	80	6	34.16	Upshur
UNT/SAND RUN	WVMTB-7-C-{0.32}	9/ 4/97	38	55	38.78	80	9	37.42	Upshur
BIG RUN	WVMTB-8	9/ 3/97	39	1	28.13	80	10	19.94	Upshur
CHILDERS RUN	WVMTB-9	9/ 3/97	39	0	19.4	80	11	20.87	Upshur
SUGAR RUN	WVMTB-10-A	9/ 2/97	39	2	4.1	80	12	57.69	Upshur
FINKS RUN	WVMTB-11	9/ 2/97	38	59	53.89	80	13	56.1	Upshur
MUDLICK RUN	WVMTB-11-B	9/ 2/97	39	0	19.8	80	15	16.88	Upshur
WASH RUN	WVMTB-11-B.5	9/ 2/97	39	0	30.74	80	16	31.57	Upshur
BRIDGE RUN	WVMTB-11-B.7	9/ 2/97	39	0	43.22	80	17	22.06	Upshur
FRENCH CREEK	WVMTB-18-{11.2}	9/ 3/97	38	53	11.77	80	18	27.23	Upshur
BULL RUN	WVMTB-18-B	9/ 3/97	38	54	18.61	80	16	47.52	Upshur

Table A-1. Sites sampled (continued)

Stream Name	Stream Code	Date	Latitude			Longitude			County
BLACKLICK RUN	WVMTB-18-B-2	9/ 3/97	38	54	28.23	80	17	11.47	Upshur
MUDLICK RUN	WVMTB-18-B-3	9/ 3/97	38	54	30.64	80	17	42.08	Upshur
LAUREL FORK/FRENCH CREEK	WVMTB-18-D-{3.9}	9/10/97	38	51	8.59	80	15	25.15	Upshur
TRUBIE RUN	WVMTB-19-{0.9}	9/ 4/97	38	55	25.81	80	12	54.56	Upshur
SAWMILL RUN	WVMTB-20	9/ 4/97	38	54	22.53	80	13	9.29	Upshur
LAUREL RUN	WVMTB-24	9/ 4/97	38	52	50.06	80	10	57.31	Upshur
TENMILE CREEK	WVMTB-25	9/17/97	38	52	25	80	11	10	Upshur
RIGHT FORK/TENMILE CREEK	WVMTB-25-A	9/17/97	38	52	8	80	10	47	Upshur
PANTHER FORK	WVMTB-27	9/16/97	38	49	51.07	80	11	55.56	Upshur
BIG RUN	WVMTB-28	9/ 9/97	38	49	9.55	80	12	59.98	Upshur
SWAMP RUN	WVMTB-29	9/ 9/97	38	48	6.59	80	12	9.29	Upshur
HEROLDS RUN	WVMTB-30	9/10/97	38	48	4	80	12	20	Upshur
RIGHT FORK/BUCKHANNON RIVER	WVMTB-31	9/ 9/97	38	46	51	80	13	45	Upshur
ALEC RUN	WVMTB-31-C	9/ 9/97	38	46	5.91	80	14	19.24	Upshur
MILLSITE RUN	WVMTB-31-D	9/ 9/97	38	45	16.12	80	13	58.16	Upshur
TROUT RUN	WVMTB-31-F-1	9/ 8/97	38	43	33.33	80	11	44.19	Randolph
UPPER TROUT RUN	WVMTB-31-F-2-{0.8}	9/ 8/97	38	41	57.03	80	12	21.87	Randolph
SALT BLOCK RUN	WVMTB-31-F-5	9/ 8/97	38	40	57.79	80	11	3.79	Randolph
MARSH FORK	WVMTB-31-J	9/15/97	38	40	45	80	14	47	Randolph
LEFT FORK/BUCKHANNON RIVER	WVMTB-32-{0.4}	9/ 8/97	38	46	52.41	80	13	1.26	Upshur
LEFT FORK/BUCKHANNON RIVER	WVMTB-32-{0.4}	9/16/97	38	46	52.41	80	13	1.26	Upshur
BEAR CAMP RUN	WVMTB-32-D	9/16/97	38	45	37	80	10	9	Upshur
BEECH RUN	WVMTB-32-H	9/ 9/97	38	41	37.1	80	7	57.6	Randolph
PHILLIPS CAMP RUN	WVMTB-32-I-1	9/15/97	38	39	2	80	7	58	Randolph
MIDDLE FORK RIVER	WVMT-33-{11.8}	8/26/97	38	57	44.04	80	3	58.78	Upshur
SWAMP RUN	WVMTM-0.5-{0.6}	8/25/97	39	1	17.53	80	4	7.49	Upshur
HANGING RUN	WVMTM-1	8/25/97	39	0	36	80	2	42	Barbour
LAUREL RUN	WVMTM-2	8/26/97	38	59	30.58	80	3	9.59	Upshur
HOOPPOLE RUN	WVMTM-3	8/25/97	38	58	31.47	80	3	42.75	Upshur
SERVICE RUN	WVMTM-5	8/26/97	38	57	10.07	80	4	27.03	Upshur
SHORT RUN	WVMTM-7	8/26/97	38	56	29.44	80	4	56.13	Randolph
RIGHT FORK/MIDDLE FORK	WVMTM-11-{0.3}	8/26/97	38	53	45.78	80	6	50.91	Upshur
RIGHT FORK/MIDDLE FORK	WVMTM-11-{7.6}	9/ 8/97	38	48	14.15	80	8	42.84	Upshur
JENKS RUN	WVMTM-11-E	8/26/97	38	50	22.21	80	8	17.62	Upshur
LONG RUN	WVMTM-13-{0.8}	9/ 8/97	38	51	41.4	80	5	7.94	Randolph
THREE FORKS RUN	WVMTM-17	8/27/97	38	49	21.25	80	2	28.84	Randolph
PLEASANT RUN	WVMTM-21	8/27/97	38	47	11.22	80	2	10.19	Randolph
SCOOLCRAFT RUN	WVMTM-25-{1.5}	8/27/97	38	45	14.91	80	4	13.06	Randolph
BIRCH FORK	WVMTM-25-A	8/27/97	38	45	27	80	3	57	Randolph
ROCKY RUN	WVMTM-26-B	9/ 9/97	38	43	41	80	4	11	Randolph
MITCHELL LICK FORK	WVMTM-27	9/ 9/97	38	44	28	80	2	45	Randolph
SHOOKS RUN	WVMT-35.5	9/10/97	39	1	14.4	79	56	2.3	Barbour
ISLAND RUN	WVMT-36	9/15/97	38	58	19.23	79	57	38.69	Barbour
BEAVER CREEK	WVMT-37-{0.0}	9/15/97	38	58	3.45	79	57	43.81	Barbour
BEAVER CREEK	WVMT-37-{2.8}	9/15/97	38	58	28.58	79	55	37.38	Barbour
BACK FORK	WVMT-38-A	9/10/97	38	58	4.6	79	59	0.2	Barbour
BIG LAUREL RUN	WVMT-40-{0.4}	9/15/97	38	57	16.03	79	59	43	Randolph
BIG LAUREL RUN	WVMT-40-{0.6}	9/15/97	38	57	14	79	59	53	Randolph
LITTLE LAUREL RUN	WVMT-40-A	9/15/97	38	57	16.03	79	59	54.61	Randolph
GRASSY RUN	WVMT-41-{1.0}	9/15/97	38	55	39.45	79	58	16.05	Randolph
ROARING CREEK	WVMT-42-{7.7}	9/16/97	38	52	28.85	79	58	38.44	Randolph
ROARING CREEK	WVMT-42-{7.7}	9/16/97	38	52	28.85	79	58	38.44	Randolph
UNT/FLATBUSH FORK	WVMT-42-B-1-{1.3}	8/25/97	38	53	5.46	80	1	37.43	Randolph
LEADING CREEK	WVMT-43-{13.2}	9/ 2/97	39	2	36.46	79	49	6.21	Randolph
LEADING CREEK	WVMT-43-{15.6}	8/27/97	39	4	8.6	79	48	38.3	Randolph

Table A-1. Sites sampled (continued)

Stream Name	Stream Code	Date	Latitude			Longitude			County
CRAVEN RUN	WVMT-43-A	8/25/97	38	56	16.2	79	51	36.36	Randolph
LOGLICK RUN	WVMT-43-F-1	8/25/97	38	59	20.5	79	48	11.61	Randolph
DAVIS LICK	WVMT-43-H	9/11/97	39	0	19	79	49	29	Randolph
CAMPFIELD RUN	WVMT-43-M	8/27/97	39	3	18.67	79	50	17.24	Randolph
LAUREL RUN	WVMT-43-O	8/27/97	39	5	14	79	49	23	Randolph
CHENOWETH CREEK	WVMT-45	8/26/97	38	53	43.03	79	51	25.15	Randolph
KINGS RUN	WVMT-48	8/26/97	38	51	29.24	79	51	36.03	Randolph
FILES CREEK	WVMT-50	8/26/97	38	50	11.99	79	52	32.15	Randolph
LIMEKILN RUN	WVMT-50-A-1	8/26/97	38	48	38.15	79	49	35.48	Randolph
HILL RUN	WVMT-50-B-3	8/26/97	38	50	4	79	47	46	Randolph
JONES RUN	WVMT-57-{0.4}	8/27/97	38	47	5.14	79	54	41.75	Randolph
SHAVERS RUN	WVMT-61-{2.0}	9/ 3/97	38	44	34.87	79	54	58.64	Randolph
MILL CREEK	WVMT-64-{6.7}	9/10/97	38	41	20	80	2	36	Randolph
BUCK RUN	WVMT-64-A.5	9/ 3/97	38	43	5.73	79	59	51.78	Randolph
GLADE RUN/MILL CREEK	WVMT-64-C	9/10/97	38	40	20	80	3	28	Randolph
MEATBOX RUN	WVMT-64-E	9/10/97	38	39	1	80	4	45	Randolph
POTATOHOLE FORK	WVMT-64-F	9/10/97	38	37	51	80	5	5	Randolph
RIFFLE CREEK	WVMT-66	9/ 2/97	38	41	40.57	79	58	33.95	Randolph
MCGEE RUN	WVMT-66-B	9/ 3/97	38	40	2.21	79	56	29.89	Randolph
BECKY CREEK	WVMT-68	9/ 3/97	38	40	32	80	0	3	Randolph
WAMSLEY RUN	WVMT-68-D	9/ 9/97	38	37	25	79	57	55	Randolph
POUNDMILL RUN	WVMT-69	9/ 9/97	38	39	31	80	0	20	Randolph
ELKWATER FORK	WVMT-74	9/ 9/97	38	36	37	80	2	3	Randolph
FORTLICK RUN	WVMT-74-B-1	9/ 9/97	38	35	51	80	4	15	Randolph
STEWART RUN	WVMT-75-{16.2}	9/ 8/97	38	33	54	79	59	3	Randolph
RALSTON RUN	WVMT-78	9/ 9/97	38	33	2	80	2	24	Randolph
WINDY RUN	WVMT-79-{0.9}	9/ 9/97	38	32	23	80	1	21	Randolph
BIG RUN	WVMT-81-{0.8}	9/ 8/97	38	30	1.5	80	2	31	Randolph

Table A-2. Physical characteristics of 100 meter stream reach

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVM-27-{115.0}	14.1	0.2	0.5	1.2
WVM-27-{46.2}	86	0.08	0.2	
WVM-27-{83.0}	20		1	1
WVM-27-{93.6}	20		1	1
WVMT-4	2.8	0.1	0.2	0.3
WVMT-5	6	0.15	0.2	0.5
WVMT-7	2.9	0.1	0.2	1
WVMT-8	7.3	0.1	0.2	1.5
WVMT-11-{6.6}	1.7	0.05	0.2	0.3
WVMT-11-A	2.8	0.01	0.25	0.5
WVMT-11-B	2.5	0.15	0.2	0.75
WVMT-11-B-1	0.7	0.05	0.15	0.25
WVMT-12-{10.2}	15.8	0.2	0.3	0.4
WVMT-18-{9.6}	2.8	0.1	0.1	0.55
WVMT-18-E-{0.4}	12			1
WVMT-18-E-3-A-{1.2}	1.2	0.02	0.06	0.23
WVMT-18-E-4-A	3.2	0.1	0.12	0.36
WVMT-18-G-2	2.5	0.05	0.1	0.15
WVMT-22	0.9	0.03	0.05	0.15
WVMT-23	17.4	0.1	0.2	0.5
WVMT-23-B-1	1	0.04	0.05	0.3
WVMT-23-C-{5.6}	3.1	0.15	0.2	
WVMT-23-F	3	0.07	0.1	0.2
WVMT-24-{0.03}	5.8	0.04	0.15	0.7
WVMT-24-A	2.1	0.05	0.1	0.2
WVMT-24-C	16	0.08	0.1	0.4
WVMT-24-C-1.5-A	0.9			0.1
WVMT-24-C-2	2.8	0.03	0.1	0.4
WVMT-24-C-3.5	4.1	0.05	0.1	0.5
WVMT-26-{0.4}	3.8	0.15	0.3	1.5
WVMT-26-B	2.1	0.06	0.3	0.5
WVMT-26-C	1.7		0.2	0.3
WVMT-29	1.9	0.05	0.08	0.3
WVMT-31-{6.6}	30		2	2
WVMTB-1	2	0.02	0.05	0.35
WVMTB-5	5	0.1	0.15	0.2
WVMTB-5-B	1.5		0.15	0.3
WVMTB-5-C	0.3	0.02		0.15
WVMTB-7-{1.0}	8.1	0.1	0.3	0.65
WVMTB-7-A-{0.5}	7	0.05	0.15	0.65
WVMTB-7-A-{2.9}	3.5	0.1	0.15	0.25
WVMTB-7-C-{0.32}	0.9	0.03	0.1	0.15
WVMTB-8	2.1	0.05	0.15	0.35
WVMTB-9	1.5	0.05	0.15	0.3
WVMTB-10-A	2.6	0.1	0.2	0.45
WVMTB-11	6.3	0.15	0.5	0.6
WVMTB-11-B	3.1	0.05		0.5
WVMTB-11-B.5	0.9	0.05		0.25
WVMTB-11-B.7	1.4	0.05	0.1	0.3
WVMTB-18-{11.2}	4.5	0.1	0.2	0.4
WVMTB-18-B	4.5	0.05	0.25	0.45
WVMTB-18-B-2	2.8	0.05	0.15	0.35
WVMTB-18-B-3	0.6	0.01		0.05
WVMTB-18-D-{3.9}	5.1	0.05		0.35
WVMTB-19-{0.9}	2.5	0.03		0.3

Table A-2. Physical characteristics of 100 M stream reach (cont.)

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVMTB-20	2.9	0.05	0.15	0.4
WVMTB-24	2.1	0.03	0.08	0.2
WVMTB-25	4.4	0.1	0.16	0.4
WVMTB-25-A	2.6	0.05	0.1	0.15
WVMTB-27	1.2	0.01	0.03	0.8
WVMTB-28	3.1	0.05	0.2	0.25
WVMTB-29	2	0.01		0.2
WVMTB-30	2.1	0.05	0.1	0.3
WVMTB-31	15.6	0.1	0.25	0.45
WVMTB-31-C	2.2	0.05	0.1	0.25
WVMTB-31-D	2.7	0.02		0.25
WVMTB-31-F-1	3.4	0.05	0.15	0.3
WVMTB-31-F-2-{0.8}	2	0.05	0.15	0.25
WVMTB-31-F-5	1.5	0.03		0.35
WVMTB-31-J	5.6	0.15	0.3	0.5
WVMTB-32-{0.4}	14.3	0.1	0.2	0.75
WVMTB-32-{0.4}	12.8	0.1	0.15	0.5
WVMTB-32-D	1.6	0.01	0.02	0.5
WVMTB-32-H	5.3	0.15	0.2	0.3
WVMTB-32-I-1	3	0.02	0.1	0.3
WVMT-33-{11.8}	28	0.1	0.25	0.5
WVMTM-0.5-{0.6}	3.9	0.1	0.15	0.5
WVMTM-1	4.8	0.05	0.1	0.7
WVMTM-2	2	0.05	0.1	0.5
WVMTM-3	5	0.1	0.15	0.3
WVMTM-5	1.2	0.03	0.05	0.3
WVMTM-7	1.2	0.04	0.1	1
WVMTM-11-{0.3}	11.8	0.15	0.2	0.5
WVMTM-11-{7.6}	3.5	0.1	0.5	1
WVMTM-11-E	5.7	0.06	0.25	0.35
WVMTM-13-{0.8}	5.6	0.1	0.15	0.25
WVMTM-17	3	0.04	0.1	0.45
WVMTM-21	1.9	0.03	0.1	0.5
WVMTM-25-{1.5}	1.9	0.03	0.1	0.2
WVMTM-25-A	2.8	0.1	0.25	0.32
WVMTM-26-B	6	0.1	0.2	0.5
WVMTM-27	1.7	0.01		0.2
WVMT-35.5	0.7			0.2
WVMT-36	1.8	0.05	0.1	0.3
WVMT-37-{0.0}	3.7	0.05	0.15	0.5
WVMT-37-{2.8}	1.2	0.05		0.3
WVMT-38-A	1.9			0.2
WVMT-40-{0.4}	3.5	0.05	0.15	0.4
WVMT-40-{0.6}	3.3	0.03		0.35
WVMT-40-A	1	0.02		0.3
WVMT-41-{1.0}	4.3	0.1	0.3	
WVMT-42-{7.7}	5.1			0.6
WVMT-42-{7.7}	6.3			0.5
WVMT-42-B-1-{1.3}	1.2	0.05	0.1	0.1
WVMT-43-{13.2}	7	0.06	0.15	0.5
WVMT-43-{15.6}	6	0.1	0.2	0.3
WVMT-43-A	4.3	0.1	0.2	0.4
WVMT-43-F-1	3.3	0.08	0.15	0.25
WVMT-43-H	2.8	0.09	0.3	
WVMT-43-M	2	0.07	0.15	0.2

Table A-2. Physical characteristics of 100 M stream reach (cont.)

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVMT-43-O	2.9	0.05	0.2	0.3
WVMT-45	5.9	0.1	0.2	0.4
WVMT-48	4.6	0.05	0.1	0.2
WVMT-50	6.5	0.07	0.3	0.5
WVMT-50-A-1	2.5	0.05	0.15	0.3
WVMT-50-B-3	2.4	0.03	0.1	0.6
WVMT-57-{0.4}	1.7	0.05	0.1	0.1
WVMT-61-{2.0}	4.6	0.05	0.07	0.2
WVMT-64-{6.7}	7.2	0.1	0.3	0.3
WVMT-64-A.5	0.7	0.02	0.08	0.1
WVMT-64-C	2	0.03	0.05	0.07
WVMT-64-E	3.8	0.02	0.02	0.3
WVMT-64-F	3.7	0.05	0.1	0.3
WVMT-66	6.1	0.07	0.1	0.5
WVMT-66-B	3.5	0.05	0.5	1
WVMT-68	4.7	0.06	0.25	0.6
WVMT-68-D	1	0.01	0.05	0.09
WVMT-69	2	0.01	0.03	0.15
WVMT-74	6.4	0.02	0.1	0.15
WVMT-74-B-1	1.4	0.01	0.05	0.1
WVMT-75-{16.2}	2.3	0.02	0.04	0.25
WVMT-78	3.9	0.05	0.1	0.2
WVMT-79-{0.9}	2.3	0.05	0.1	0.15
WVMT-81-{0.8}	2.1	0.02	0.08	0.8

Blanks indicate not measured for stream width or habitat type not present for depths

Table A-3. Observed Sediment Characteristics

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVM-27-{115.0}	anaerobic	absent	sand,silt
WVM-27-{46.2}	normal	absent	sand,silt,metal hydroxides
WVM-27-{83.0}	normal	absent	sand,silt
WVM-27-{93.6}	normal	absent	sand,silt
WVMT-4	normal	absent	sand,silt,metal hydroxides
WVMT-5	none	absent	sand
WVMT-7	none	absent	sand,silt
WVMT-8	none	absent	sand,silt,metal hydroxides
WVMT-11-{6.6}	none	absent	sand,silt
WVMT-11-A	normal	absent	sand,silt,metal hydroxides
WVMT-11-B	none	absent	sand,silt
WVMT-11-B-1	anaerobic	absent	sand,silt
WVMT-12-{10.2}	normal	absent	sand,silt
WVMT-18-{9.6}	normal	absent	sand,silt,clay
WVMT-18-E-{0.4}	anaerobic	absent	sand,silt,metal hydroxides
WVMT-18-E-3-A-{1	none	absent	sand,silt
WVMT-18-E-4-A	normal	absent	sand,silt
WVMT-18-G-2	anaerobic	absent	sand,silt
WVMT-22	normal	absent	sand,silt
WVMT-23	normal	absent	sand,silt
WVMT-23-B-1	none	absent	sand,silt
WVMT-23-C-{5.6}	normal	absent	sand,silt
WVMT-23-F	normal	absent	sand,silt
WVMT-24-{0.03}	normal	absent	sand,silt
WVMT-24-A	normal	absent	sand,silt
WVMT-24-C	normal	absent	sand,silt
WVMT-24-C-1.5-A	normal	absent	sand,silt,metal hydroxides
WVMT-24-C-2	normal	absent	sand,silt,metal hydroxides
WVMT-24-C-3.5	normal	absent	sand,silt
WVMT-26-{0.4}	anaerobic	absent	sand,silt
WVMT-26-B	normal	absent	sand,silt,clay
WVMT-26-C	anaerobic	absent	sand, silt
WVMT-29	anaerobic	absent	sand,silt
WVMT-31-{6.6}	normal	absent	sand,silt,clay
WVMTB-1	chemical	absent	clay
WVMTB-5	normal	absent	sand
WVMTB-5-B	anaerobic	absent	sand,silt,clay
WVMTB-5-C	normal	absent	sand,silt,metal hydroxides
WVMTB-7-{1.0}	normal	absent	sand,silt
WVMTB-7-A-{0.5}	normal	absent	sand,silt
WVMTB-7-A-{2.9}	normal	absent	sand,silt
WVMTB-7-C-{0.32}	normal	absent	sand,silt
WVMTB-8	normal	absent	sand,silt
WVMTB-9	normal	absent	sand,silt
WVMTB-10-A	sewage	absent	sand,silt,metal hydroxides
WVMTB-11	normal	absent	sand,silt,metal hydroxides
WVMTB-11-B	chemical	slight	sand,silt,metal hydroxides
WVMTB-11-B.5	normal	slight	sand,silt
WVMTB-11-B.7	normal	absent	sand,metal hydroxides
WVMTB-18-{11.2}	normal	absent	sand,silt,metal hydroxides
WVMTB-18-B	normal	absent	sand,silt,metal hydroxides
WVMTB-18-B-2	normal	absent	sludge,sand,silt,metal hydroxides
WVMTB-18-B-3	manure	absent	sand,silt,manure
WVMTB-18-D-{3.9}	normal	absent	sand,silt
WVMTB-19-{0.9}	normal	absent	sand,silt

Table A-3. Observed Sediment Characteristics (continued)

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVMTB-20	normal	absent	sand,silt
WVMTB-24	normal	absent	sand,silt
WVMTB-25	normal	absent	metal hydroxides
WVMTB-25-A	none	absent	sand,silt
WVMTB-27	none	absent	sand,silt
WVMTB-28	normal	absent	sand,silt
WVMTB-29	none	absent	sand,metal hydroxides
WVMTB-30	normal	absent	sand,silt
WVMTB-31	normal	absent	sand,silt
WVMTB-31-C	normal	absent	sand
WVMTB-31-D	normal	absent	sand,silt
WVMTB-31-F-1	normal	absent	sand,silt
WVMTB-31-F-2-{0.	sewage	absent	sand,silt
WVMTB-31-F-5	normal	absent	sand
WVMTB-31-J	normal	absent	sand,silt
WVMTB-32-{0.4}	normal	slight	sand,silt,metal hydroxides
WVMTB-32-{0.4}	normal	moderate	sand,silt,metal hydroxides
WVMTB-32-D	normal	absent	sand,silt
WVMTB-32-H	normal	absent	sand
WVMTB-32-I-1	normal	absent	sand,silt
WVMT-33-{11.8}	normal	absent	sand
WVMTM-0.5-{0.6}	normal	absent	sand,silt
WVMTM-1	normal	absent	sand,silt
WVMTM-2	normal	absent	sand,silt
WVMTM-3	iron	moderate	sand,silt,metal hydroxides
WVMTM-5	normal	absent	sand,silt
WVMTM-7	iron	absent	sand,metal hydroxides
WVMTM-11-{0.3}	normal	absent	sand,silt
WVMTM-11-{7.6}	normal	absent	sand,silt
WVMTM-11-E	normal	absent	sand,silt
WVMTM-13-{0.8}	normal	absent	sand,silt
WVMTM-17	normal	absent	sand,silt,metal hydroxides
WVMTM-21	normal	absent	sand,silt
WVMTM-25-{1.5}	normal	absent	sand,silt
WVMTM-25-A	normal	absent	sand,silt
WVMTM-26-B	normal	absent	sand
WVMTM-27	normal	absent	sand
WVMT-35.5	normal	absent	sand,silt
WVMT-36	normal	absent	sand,silt
WVMT-37-{0.0}	normal	slight	sand,silt,metal hydroxides
WVMT-37-{2.8}	normal	absent	sand,silt,metal hydroxides
WVMT-38-A	normal	absent	sand,silt
WVMT-40-{0.4}	normal	absent	sand,silt
WVMT-40-{0.6}	normal	slight	sand,silt,metal hydroxides
WVMT-40-A	normal	slight	sand,silt
WVMT-41-{1.0}	sewage	moderate	sludge,sand,silt,metal hydroxides
WVMT-42-{7.7}	normal	absent	sand, silt
WVMT-42-{7.7}	normal	absent	sand,silt
WVMT-42-B-1-{1.3	normal	absent	sand,silt,clay
WVMT-43-{13.2}	none	absent	silt
WVMT-43-{15.6}	normal	absent	sand,silt
WVMT-43-A	anaerobic	absent	sand,silt,clay
WVMT-43-F-1	normal	absent	sand
WVMT-43-H	anaerobic	absent	silt,clay
WVMT-43-M	normal	absent	sand

Table A-3. Observed Sediment Characteristics (continued)

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVMT-43-O	normal	absent	sand,silt,clay
WVMT-45	normal	absent	sand,silt
WVMT-48	normal	absent	sand,silt
WVMT-50	normal	absent	sand,silt
WVMT-50-A-1	normal	absent	sand,silt
WVMT-50-B-3	normal	absent	sand,silt
WVMT-57-{0.4}	normal	absent	sand,silt
WVMT-61-{2.0}	none	absent	sand
WVMT-64-{6.7}	normal	absent	sand
WVMT-64-A.5	none	absent	sand,silt
WVMT-64-C	normal	absent	sand,silt
WVMT-64-E	none	absent	sand,silt
WVMT-64-F	none	absent	sand,silt
WVMT-66	none	absent	sludge
WVMT-66-B	none	absent	sand,silt
WVMT-68	none	absent	silt
WVMT-68-D	normal	absent	sand,silt
WVMT-69	normal	absent	sand,silt
WVMT-74	normal	absent	sand,silt
WVMT-74-B-1	normal	absent	sand,silt
WVMT-75-{16.2}	normal	absent	sand,silt
WVMT-78	normal	absent	sand,silt
WVMT-79-{0.9}	normal	absent	sand,silt
WVMT-81-{0.8}	normal	absent	sand,silt

Table A-4. Substrate composition in benthic collection area

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
WVM-27-{115.0}	0	0	40	35	5	20	0
WVM-27-{46.2}	0	0	10	10	60	15	5
WVMT-4	0	10	50	20	15	5	0
WVMT-5	0	25	50	15	5	5	0
WVMT-7	10	5	40	20	20	5	0
WVMT-8	0	5	60	10	20	5	0
WVMT-11-{6.6}	0	5	60	20	10	5	0
WVMT-11-A	0	0	50	10	30	10	0
WVMT-11-B	0	0	15	50	20	15	0
WVMT-11-B-1	0	0	0	10	20	50	20
WVMT-12-{10.2}	0	25	45	5	20	5	0
WVMT-18-{9.6}	0	0	10	10	60	5	15
WVMT-18-E-{0.4}	0	0	0	0	70	10	20
WVMT-18-E-3-A-{1.2}	0	0	60	25	10	5	0
WVMT-18-E-4-A	0	30	40	20	5	5	0
WVMT-18-G-2	0	5	60	20	10	5	0
WVMT-22	0	40	30	15	10	5	0
WVMT-23	0	20	40	30	10	0	0
WVMT-23-B-1	0	10	60	20	5	5	0
WVMT-23-C-{5.6}	0	20	60	10	5	5	0
WVMT-23-F	0	5	50	25	15	5	0
WVMT-24-{0.03}	0	30	30	10	20	10	0
WVMT-24-A	0	10	20	50	15	5	0
WVMT-24-C	50	0	15	10	10	10	5
WVMT-24-C-2	15	0	20	25	30	10	0
WVMT-24-C-3.5	25	5	40	5	15	10	0
WVMT-26-{0.4}	0	60	10	10	10	5	5
WVMT-26-B	0	0	60	0	10	10	20
WVMT-26-C	2	2.5	0	20	20	30	25
WVMT-29	0	0	0	40	40	5	15
WVMT-31-{6.6}	0	15	35	10	25	10	5
WVMTB-1	0	10	40	30	15	5	0
WVMTB-5	0	5	40	35	15	5	0
WVMTB-5-B	0	0	0	0	20	30	50
WVMTB-5-C	0	0	0	0	30	30	40
WVMTB-7-{1.0}	0	0	30	45	25	0	0
WVMTB-7-A-{0.5}	40	0	25	15	10	10	0
WVMTB-7-A-{2.9}	0	5	30	40	25	0	0
WVMTB-7-C-{0.32}	0	0	30	40	20	10	0
WVMTB-8	0	5	45	30	15	0	5
WVMTB-9	0	5	20	35	25	0	15
WVMTB-10-A	0	0	0	50	30	5	15
WVMTB-11	0	10	20	40	30	0	0
WVMTB-11-B	0	0	15	40	35	5	5
WVMTB-11-B.5	0	0	15	45	15	5	20
WVMTB-18-{11.2}	0	0	5	5	50	40	0
WVMTB-18-B	0	0	20	50	20	0	10
WVMTB-18-B-2	0	0	20	50	20	5	5
WVMTB-18-B-3	0	0	10	25	10	25	30
WVMTB-18-D-{3.9}	0	20	25	5	30	20	0
WVMTB-19-{0.9}	0	5	30	30	30	5	0
WVMTB-20	0	0	30	50	20	0	0

Table A-4. Substrate composition in benthic collection area (continued)

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
WVMTB-24	10	5	25	35	20	5	0
WVMTB-25	0	5	50	20	5	20	0
WVMTB-25-A	0	5	40	40	10	5	0
WVMTB-27	0	10	50	20	20	0	0
WVMTB-28	0	15	40	15	25	5	0
WVMTB-29	0	10	45	30	15	0	0
WVMTB-30	0	0	30	40	20	10	0
WVMTB-31	0	5	60	25	5	5	0
WVMTB-31-C	0	1	65	15	19	0	0
WVMTB-31-D	0	15	30	15	10	30	0
WVMTB-31-F-1	0	5	35	30	5	25	0
WVMTB-31-F-2-{0.8}	0	10	60	25	5	0	0
WVMTB-31-F-5	0	0	57	40	3	0	0
WVMTB-31-J	0	10	50	0	30	10	0
WVMTB-32-{0.4}	0	1	50	30	10	9	0
WVMTB-32-{0.4}	0	10	60	20	10	0	0
WVMTB-32-D	0	20	50	25	5	0	0
WVMTB-32-H	0	10	60	20	10	0	0
WVMTB-32-I-1	0	5	45	35	10	5	0
WVMT-33-{11.8}	0	20	60	10	10	0	0
WVMTM-0.5-{0.6}	0	50	25	0	15	10	0
WVMTM-1	0	0	50	15	30	5	0
WVMTM-2	0	5	60	20	10	5	0
WVMTM-3	0	10	60	20	10	0	0
WVMTM-5	0	10	60	20	10	0	0
WVMTM-7	0	0	60	20	20	0	0
WVMTM-11-{0.3}	0	10	60	20	10	0	0
WVMTM-11-{7.6}	0	30	40	20	10	0	0
WVMTM-11-E	0	10	60	20	10	0	0
WVMTM-13-{0.8}	0	10	60	20	10	0	0
WVMTM-17	0	10	50	20	20	0	0
WVMTM-21	0	0	60	30	10	0	0
WVMTM-25-{1.5}	0	0	60	30	10	0	0
WVMTM-25-A	0	0	70	20	10	0	0
WVMTM-26-B	0	10	50	30	10	0	0
WVMTM-27	0	20	60	10	10	0	0
WVMT-35.5	0	0	15	10	50	25	0
WVMT-36	0	20	40	25	15	0	0
WVMT-37-{0.0}	0	20	30	30	15	5	0
WVMT-37-{2.8}	0	0	10	20	60	0	10
WVMT-38-A	0	0	80	10	10	0	0
WVMT-40-{0.4}	0	15	30	20	30	5	0
WVMT-40-{0.6}	0	10	35	30	20	5	0
WVMT-40-A	0	10	25	15	50	0	0
WVMT-41-{1.0}	0	10	20	10	20	20	20
WVMT-42-{7.7}	0	5	5	25	45	20	0
WVMT-42-{7.7}	0	0	0	30	50	20	0
WVMT-42-B-1-{1.3}	0	0	20	40	30	10	0
WVMT-43-{13.2}	0	10	65	5	10	10	0
WVMT-43-{15.6}	0	0	20	40	25	5	10
WVMT-43-A	0	0	15	40	25	5	15
WVMT-43-F-1	0	5	20	40	30	5	0
WVMT-43-H	0	0	0	0	0	5	95

Table A-4. Substrate composition in benthic collection area (continued)

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
WVMT-43-M	0	5	40	30	25	0	0
WVMT-43-O	0	0	15	40	30	5	10
WVMT-45	5	5	45	20	10	10	5
WVMT-48	5	0	35	40	10	5	5
WVMT-50	0	0	60	25	10	5	0
WVMT-50-A-1	10	10	40	20	15	5	0
WVMT-50-B-3	15	15	50	10	10	0	0
WVMT-57-{0.4}	5	0	30	40	20	5	0
WVMT-61-{2.0}	0	2	38	50	10	0	0
WVMT-64-{6.7}	0	10	45	40	5	0	0
WVMT-64-A.5	0	2	50	30	10	8	0
WVMT-64-C	0	0	35	35	28	2	0
WVMT-64-E	0	5	50	35	8	2	0
WVMT-64-F	0	5	50	35	10	0	0
WVMT-66	0	20	50	30	0	0	0
WVMT-66-B	0	5	20	40	30	5	0
WVMT-68	0	0	60	25	10	5	0
WVMT-68-D	0	0	25	45	29	1	0
WVMT-69	0	0	25	55	20	0	0
WVMT-74	0	5	35	45	10	5	0
WVMT-74-B-1	0	0	50	35	10	5	0
WVMT-75-{16.2}	0	5	40	30	25	0	0
WVMT-78	0	0	40	40	15	5	0
WVMT-79-{0.9}	0	5	40	35	15	5	0
WVMT-81-{0.8}	0	5	35	40	20	0	0

Table A-5. Macrobenthic community metrics and WVSCI scores

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVM-27-{115.0}	19	8	30.32	49.32	10.41	4.33	72.43
WVM-27-{46.2}	13	10	64.00	44.00	26.29	4.53	74.59
WVMT-4	2	1	66.67	100.00	0.00	4.67	44.15
WVMT-5	16	8	50.00	41.67	6.94	4.09	76.75
WVMT-7	14	6	40.00	48.57	12.14	4.23	67.79
WVMT-8	13	6	23.65	64.19	13.51	4.38	59.38
WVMT-11-{6.6}	8	3	51.15	54.20	3.05	4.18	61.39
WVMT-11-A	12	4	49.80	73.91	3.16	4.39	59.95
WVMT-11-B	11	3	20.59	47.06	8.82	6.71	53.18
WVMT-11-B-1	20	4	14.04	31.58	7.02	5.63	66.12
WVMT-12-{10.2}	6	1	8.33	66.67	41.67	5.33	37.01
WVMT-18-{9.6}	13	4	6.25	86.61	62.50	5.87	36.08
WVMT-18-E-{0.4}	8	0	0.00	46.67	20.00	4.93	45.60
WVMT-18-E-3-A-{1.2}	18	10	50.50	38.61	15.84	4.15	80.15
WVMT-18-E-4-A	15	9	45.87	45.87	24.77	4.65	71.08
WVMT-18-G-2	14	6	63.27	51.02	2.04	4.77	71.81
WVMT-22	13	7	62.50	32.50	10.00	3.40	77.93
WVMT-23	16	9	59.32	44.11	1.14	3.92	80.45
WVMT-23-B-1	12	5	34.07	60.44	1.10	3.97	63.22
WVMT-23-C-{5.6}	13	9	88.41	54.35	8.70	3.03	81.51
WVMT-23-F	12	6	76.92	40.38	15.38	4.20	74.54
WVMT-24-{0.03}	14	7	73.19	45.65	7.97	4.25	76.49
WVMT-24-A	10	2	59.90	88.83	31.47	5.21	47.04
WVMT-24-C	17	6	56.91	48.78	7.32	5.40	71.25
WVMT-24-C-1.5-A	10	2	16.67	33.33	0.00	5.42	57.62
WVMT-24-C-2	11	5	34.38	46.88	23.44	4.45	61.14
WVMT-24-C-3.5	11	5	62.86	51.43	7.14	4.11	68.63
WVMT-26-{0.4}	14	3	54.92	75.41	27.05	5.39	54.41
WVMT-26-B	9	2	25.21	81.51	57.14	5.53	36.80
WVMT-26-C	21	3	3.37	49.44	32.58	6.69	53.40
WVMT-29	11	3	39.81	75.73	46.60	5.49	45.70
WVMT-31-{6.6}	12	2	11.36	56.82	15.91	5.16	50.91
WVMTB-1	11	5	57.04	57.04	3.52	3.95	67.11
WVMTB-5	17	6	70.46	64.86	6.76	4.40	71.95
WVMTB-5-B	13	0	0.00	75.89	2.13	7.13	39.80
WVMTB-5-C	9	2	4.55	66.36	15.45	5.94	43.06
WVMTB-7-{1.0}	17	9	71.73	44.05	4.76	4.03	82.65
WVMTB-7-A-{0.5}	14	9	63.96	68.02	33.33	4.71	66.21
WVMTB-7-A-{2.9}	16	6	45.22	44.35	31.30	4.50	67.55
WVMTB-7-C-{0.32}	15	8	67.05	42.05	6.82	4.00	79.18
WVMTB-8	10	4	56.44	57.67	17.18	4.72	60.65
WVMTB-9	15	6	17.12	59.46	50.45	5.47	52.24
WVMTB-10-A	8	2	13.76	87.16	74.31	5.75	29.05
WVMTB-11	10	2	35.33	71.33	38.00	6.15	43.85
WVMTB-11-B	4	0	0.00	92.59	18.52	8.89	21.43
WVMTB-11-B.5	10	2	3.52	84.51	66.20	6.60	28.85
WVMTB-18-{11.2}	17	7	34.09	58.33	40.15	5.29	60.63
WVMTB-18-B	11	3	70.29	81.16	12.32	5.12	56.44
WVMTB-18-B-2	2	0	0.00	100.00	33.33	6.67	20.63
WVMTB-18-B-3	17	2	3.60	65.77	58.56	6.06	41.84
WVMTB-18-D-{3.9}	19	9	71.93	58.77	9.65	4.46	78.62
WVMTB-19-{0.9}	21	8	40.88	40.88	8.76	4.61	77.74
WVMTB-20	5	3	82.08	90.57	6.60	5.13	52.30
WVMTB-24	6	3	86.32	84.62	5.98	4.78	56.35
WVMTB-25	8	2	69.70	87.88	21.21	5.09	49.49

Table A-5. Macrobenthic community metrics and WVSCI scores (cont.)

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVMTB-25-A	16	9	58.24	45.05	26.37	3.96	75.69
WVMTB-27	13	6	57.94	71.03	35.51	4.64	59.51
WVMTB-28	17	10	36.15	57.75	45.54	5.17	64.37
WVMTB-30	14	5	73.64	62.73	12.73	4.34	68.57
WVMTB-31	15	9	73.31	62.71	13.14	4.69	73.53
WVMTB-31-C	14	8	92.25	66.67	3.10	3.68	77.86
WVMTB-31-D	14	11	76.72	55.17	20.69	4.26	77.63
WVMTB-31-F-1	15	9	63.70	62.96	24.44	4.60	70.03
WVMTB-31-F-2-{0.8}	18	11	78.70	58.33	13.89	3.89	82.35
WVMTB-31-F-5	15	11	85.26	63.16	9.47	4.14	80.06
WVMTB-31-J	15	9	76.11	61.06	9.73	4.32	75.92
WVMTB-32-{0.4}	14	9	78.42	53.77	15.75	4.28	76.51
WVMTB-32-{0.4}	13	7	76.87	38.06	15.67	4.19	77.20
WVMTB-32-D	13	7	59.34	65.93	31.87	4.84	62.52
WVMTB-32-H	14	9	60.93	43.72	23.72	4.57	73.95
WVMTB-32-I-1	11	8	76.79	41.07	15.18	2.25	79.20
WVMT-33-{11.8}	10	6	57.40	59.76	2.37	4.82	65.10
WVMTM-0.5-{0.6}	18	7	32.93	34.15	12.20	4.04	74.68
WVMTM-1	17	7	65.84	47.20	11.80	3.78	77.60
WVMTM-2	22	13	46.22	36.97	15.97	4.30	85.65
WVMTM-3	3	2	66.67	77.78	33.33	4.67	46.56
WVMTM-5	13	7	72.65	51.28	13.68	3.24	75.55
WVMTM-7	18	9	78.79	58.79	10.91	4.05	79.80
WVMTM-11-{0.3}	19	10	44.61	59.11	12.27	4.54	74.22
WVMTM-11-{7.6}	18	10	77.23	41.58	7.92	3.78	86.42
WVMTM-11-E	16	10	85.03	63.95	9.52	4.31	78.92
WVMTM-13-{0.8}	18	10	85.20	74.01	5.05	4.46	78.30
WVMTM-17	15	6	8.91	70.30	55.45	5.07	48.02
WVMTM-21	15	5	44.55	62.73	24.55	4.81	60.99
WVMTM-25-{1.5}	13	10	85.85	45.37	6.83	3.37	84.19
WVMTM-25-A	17	13	95.53	64.63	1.22	3.72	87.40
WVMTM-26-B	10	6	54.00	72.00	40.67	4.68	55.19
WVMTM-27	15	9	63.86	51.81	28.92	3.90	73.85
WVMT-35.5	11	0	0.00	81.90	71.43	6.40	26.70
WVMT-36	10	2	50.00	71.05	23.68	5.34	50.89
WVMT-37-{0.0}	6	0	0.00	81.97	60.66	5.38	26.93
WVMT-37-{2.8}	10	4	60.00	49.52	7.62	3.45	68.02
WVMT-38-A	9	5	69.23	65.38	23.08	4.92	59.99
WVMT-40-{0.4}	12	5	56.67	61.11	21.11	4.32	62.94
WVMT-40-{0.6}	12	6	63.16	47.37	20.00	4.35	69.11
WVMT-40-A	13	7	41.24	46.39	23.71	4.33	66.88
WVMT-42-{7.7}	8	3	32.93	58.54	31.71	4.89	50.45
WVMT-42-{7.7}	8	2	20.69	62.07	37.93	5.28	44.08
WVMT-42-B-1-{1.3}	6	3	17.71	77.08	59.38	5.39	35.46
WVMT-43-{13.2}	13	5	54.28	59.48	11.15	4.52	64.95
WVMT-43-{15.6}	17	7	53.74	47.33	3.91	4.15	75.83
WVMT-43-A	10	3	15.00	57.00	36.00	6.12	45.58
WVMT-43-F-1	18	12	89.51	52.81	6.74	3.93	88.13
WVMT-43-H	8	2	11.83	66.67	50.54	6.42	36.47
WVMT-43-M	19	11	77.20	52.87	11.11	4.35	83.67
WVMT-43-O	15	6	39.62	72.64	39.62	4.68	56.56
WVMT-45	19	8	64.24	56.29	7.28	4.47	76.96
WVMT-48	16	5	42.00	54.67	21.33	4.78	64.03
WVMT-50	19	10	61.92	39.75	14.23	4.42	82.35
WVMT-50-A-1	15	12	81.68	49.01	14.36	3.84	84.27

Table A-5. Macrobenthic community metrics and WVSCI scores (cont.)

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVMT-50-B-3	15	10	87.88	54.55	3.03	3.83	83.30
WVMT-57-{0.4}	16	8	62.80	38.41	18.29	4.02	78.18
WVMT-61-{2.0}	15	8	83.64	57.01	12.15	4.04	77.31
WVMT-64-{6.7}	16	11	78.34	44.01	18.89	3.93	83.49
WVMT-64-A.5	13	8	60.64	48.94	22.34	4.49	70.88
WVMT-64-C	19	12	82.78	47.02	8.61	3.82	89.16
WVMT-64-E	13	9	72.64	44.34	19.81	2.82	79.69
WVMT-64-F	13	9	88.27	66.05	9.88	1.62	78.54
WVMT-66	16	7	40.85	76.76	41.55	5.44	55.67
WVMT-66-B	7	4	18.32	87.79	77.86	5.60	31.23
WVMT-68	19	11	72.68	56.93	23.91	4.28	79.80
WVMT-68-D	16	10	72.39	58.96	14.93	4.10	77.49
WVMT-69	12	7	28.15	77.78	66.67	5.40	45.80
WVMT-74	20	10	74.78	56.42	7.30	3.40	84.69
WVMT-74-B-1	20	11	64.46	46.39	3.61	3.64	86.77
WVMT-75-{16.2}	28	17	79.03	33.96	5.32	3.61	95.26
WVMT-78	15	8	59.80	47.18	17.94	4.13	74.36
WVMT-79-{0.9}	17	12	84.97	35.75	7.25	3.41	92.02
WVMT-81-{0.8}	20	13	85.60	69.43	8.58	4.16	85.12

See pages 20-21 for explanations of the metrics.

Table A-6. Numbers of each taxon found at each sample site.

Sample site	Taxa	No. of individuals
WVM-27-{115.0}	Elmidae	63
WVM-27-{115.0}	Pleuroceridae	46
WVM-27-{115.0}	Isonychiidae	6
WVM-27-{115.0}	Hydropsychidae	24
WVM-27-{115.0}	Philopotamidae	1
WVM-27-{115.0}	Oligochaeta	2
WVM-27-{115.0}	Perlidae	2
WVM-27-{115.0}	Baetidae	3
WVM-27-{115.0}	Aeshnidae	1
WVM-27-{115.0}	Helicopsychidae	1
WVM-27-{115.0}	Psephenidae	3
WVM-27-{115.0}	Corydalidae	2
WVM-27-{115.0}	Athericidae	3
WVM-27-{115.0}	Heptageniidae	29
WVM-27-{115.0}	Chironomidae	23
WVM-27-{115.0}	Simuliidae	8
WVM-27-{115.0}	Empididae	2
WVM-27-{115.0}	Tipulidae	1
WVM-27-{115.0}	Pteronarcyidae	1
WVM-27-{46.2}	Elmidae	6
WVM-27-{46.2}	Baetidae	31
WVM-27-{46.2}	Caenidae	1
WVM-27-{46.2}	Chironomidae	46
WVM-27-{46.2}	Ephemerellidae	2
WVM-27-{46.2}	Heptageniidae	14
WVM-27-{46.2}	Tricorythidae	3
WVM-27-{46.2}	Isonychiidae	8
WVM-27-{46.2}	Hydropsychidae	20
WVM-27-{46.2}	Hydroptilidae	3
WVM-27-{46.2}	Philopotamidae	29
WVM-27-{46.2}	Polycentropodidae	1
WVM-27-{46.2}	Simuliidae	11
WVMT-4	Hydropsychidae	2
WVMT-4	Elmidae	1
WVMT-5	Gomphidae	1
WVMT-5	Baetidae	23
WVMT-5	Simuliidae	1
WVMT-5	Tipulidae	15
WVMT-5	Veliidae	1
WVMT-5	Corydalidae	5
WVMT-5	Ephemeridae	3
WVMT-5	Elmidae	37
WVMT-5	Isonychiidae	1
WVMT-5	Perlidae	3
WVMT-5	Capniidae/Leuctrid	1
WVMT-5	Philopotamidae	5
WVMT-5	Hydropsychidae	19
WVMT-5	Chironomidae	10
WVMT-5	Heptageniidae	17
WVMT-5	Psephenidae	2
WVMT-7	Simuliidae	1
WVMT-7	Tipulidae	3
WVMT-7	Corydalidae	2
WVMT-7	Psephenidae	7
WVMT-7	Elmidae	47
WVMT-7	Perlidae	10
WVMT-7	Capniidae/Leuctrid	1
WVMT-7	Philopotamidae	7
WVMT-7	Hydropsychidae	5
WVMT-7	Heptageniidae	12
WVMT-7	Baetidae	21
WVMT-7	Cambaridae	2
WVMT-7	Oligochaeta	5
WVMT-7	Chironomidae	17
WVMT-8	Perlidae	5
WVMT-8	Hydropsychidae	17
WVMT-8	Cambaridae	1
WVMT-8	Baetidae	1
WVMT-8	Psephenidae	3
WVMT-8	Isonychiidae	3
WVMT-8	Philopotamidae	2
WVMT-8	Elmidae	75
WVMT-8	Corydalidae	4
WVMT-8	Tipulidae	1
WVMT-8	Simuliidae	9
WVMT-8	Chironomidae	20
WVMT-8	Heptageniidae	7
WVMT-11-{6.6}	Heptageniidae	37
WVMT-11-{6.6}	Baetidae	12
WVMT-11-{6.6}	Hydropsychidae	18
WVMT-11-{6.6}	Gomphidae	1
WVMT-11-{6.6}	Elmidae	23
WVMT-11-{6.6}	Psephenidae	34
WVMT-11-{6.6}	Tipulidae	2
WVMT-11-{6.6}	Chironomidae	4
WVMT-11-A	Gammaridae	1
WVMT-11-A	Chironomidae	8
WVMT-11-A	Elmidae	105
WVMT-11-A	Philopotamidae	5
WVMT-11-A	Baetidae	37
WVMT-11-A	Isonychiidae	2
WVMT-11-A	Hydropsychidae	82
WVMT-11-A	Simuliidae	3
WVMT-11-A	Tipulidae	6
WVMT-11-A	Corydalidae	2
WVMT-11-A	Cambaridae	1
WVMT-11-A	Oligochaeta	1
WVMT-11-B	Chironomidae	3
WVMT-11-B	Tabanidae	3
WVMT-11-B	Tipulidae	1
WVMT-11-B	Elmidae	4
WVMT-11-B	Dryopidae	1
WVMT-11-B	Cordulegastridae	1
WVMT-11-B	Capniidae/Leuctrid	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-11-B	Gammaridae	2
WVMT-11-B	Oligochaeta	12
WVMT-11-B	Hydropsychidae	3
WVMT-11-B	Caenidae	3
WVMT-11-B-1	Corydalidae	1
WVMT-11-B-1	Chironomidae	4
WVMT-11-B-1	Tabanidae	1
WVMT-11-B-1	Tipulidae	1
WVMT-11-B-1	Sialidae	8
WVMT-11-B-1	Elmidae	1
WVMT-11-B-1	Corduliidae	4
WVMT-11-B-1	Coenagrionidae	6
WVMT-11-B-1	Calopterygidae	5
WVMT-11-B-1	Lymnaeidae	1
WVMT-11-B-1	Veliidae	1
WVMT-11-B-1	Oligochaeta	1
WVMT-11-B-1	Gomphidae	3
WVMT-11-B-1	Planorbidae	10
WVMT-11-B-1	Cambaridae	1
WVMT-11-B-1	Caenidae	2
WVMT-11-B-1	Leptoceridae	1
WVMT-11-B-1	Phryganeidae	1
WVMT-11-B-1	Aeshnidae	1
WVMT-11-B-1	Baetidae	4
WVMT-12-{10.2}	Elmidae	1
WVMT-12-{10.2}	Chironomidae	5
WVMT-12-{10.2}	Tipulidae	1
WVMT-12-{10.2}	Polycentropodidae	1
WVMT-12-{10.2}	Corydalidae	3
WVMT-12-{10.2}	Veliidae	1
WVMT-18-{9.6}	Gerridae	1
WVMT-18-{9.6}	Hydroptilidae	1
WVMT-18-{9.6}	Baetidae	2
WVMT-18-{9.6}	Heptageniidae	1
WVMT-18-{9.6}	Hydropsychidae	3
WVMT-18-{9.6}	Elmidae	1
WVMT-18-{9.6}	Corydalidae	1
WVMT-18-{9.6}	Tipulidae	1
WVMT-18-{9.6}	Ceratopogonidae	1
WVMT-18-{9.6}	Empididae	1
WVMT-18-{9.6}	Simuliidae	27
WVMT-18-{9.6}	Tabanidae	2
WVMT-18-{9.6}	Chironomidae	70
WVMT-18-E-{0.4}	Coenagrionidae	1
WVMT-18-E-{0.4}	Chironomidae	3
WVMT-18-E-{0.4}	Gerridae	1
WVMT-18-E-{0.4}	Sialidae	3
WVMT-18-E-{0.4}	Dytiscidae	1
WVMT-18-E-{0.4}	Aeshnidae	4
WVMT-18-E-{0.4}	Cambaridae	1
WVMT-18-E-{0.4}	Corydalidae	1
WVMT-18-E-3-A-{1.2}	Corydalidae	6
WVMT-18-E-3-A-{1.2}	Philopotamidae	3
WVMT-18-E-3-A-{1.2}	Ceratopogonidae	1
WVMT-18-E-3-A-{1.2}	Tipulidae	14
WVMT-18-E-3-A-{1.2}	Elmidae	9
WVMT-18-E-3-A-{1.2}	Gomphidae	1
WVMT-18-E-3-A-{1.2}	Aeshnidae	1
WVMT-18-E-3-A-{1.2}	Capniidae/Leuctrid	1
WVMT-18-E-3-A-{1.2}	Rhyacophilidae	4
WVMT-18-E-3-A-{1.2}	Hydropsychidae	23
WVMT-18-E-3-A-{1.2}	Heptageniidae	7
WVMT-18-E-3-A-{1.2}	Ephemerellidae	1
WVMT-18-E-3-A-{1.2}	Baetidae	7
WVMT-18-E-3-A-{1.2}	Cambaridae	2
WVMT-18-E-3-A-{1.2}	Ephemeridae	1
WVMT-18-E-3-A-{1.2}	Chironomidae	16
WVMT-18-E-3-A-{1.2}	Perlidae	3
WVMT-18-E-3-A-{1.2}	Leptophlebiidae	1
WVMT-18-E-4-A	Psephenidae	18
WVMT-18-E-4-A	Baetidae	17
WVMT-18-E-4-A	Cambaridae	1
WVMT-18-E-4-A	Oligochaeta	1
WVMT-18-E-4-A	Ephemeridae	1
WVMT-18-E-4-A	Tipulidae	3
WVMT-18-E-4-A	Elmidae	9
WVMT-18-E-4-A	Perlidae	1
WVMT-18-E-4-A	Philopotamidae	3
WVMT-18-E-4-A	Hydroptilidae	1
WVMT-18-E-4-A	Hydropsychidae	23
WVMT-18-E-4-A	Isonychiidae	1
WVMT-18-E-4-A	Leptophlebiidae	1
WVMT-18-E-4-A	Heptageniidae	2
WVMT-18-E-4-A	Chironomidae	27
WVMT-18-G-2	Hydropsychidae	38
WVMT-18-G-2	Tipulidae	6
WVMT-18-G-2	Muscidae	1
WVMT-18-G-2	Chironomidae	2
WVMT-18-G-2	Ceratopogonidae	5
WVMT-18-G-2	Corydalidae	4
WVMT-18-G-2	Elmidae	11
WVMT-18-G-2	Chloroperlidae	1
WVMT-18-G-2	Polycentropodidae	2
WVMT-18-G-2	Heptageniidae	5
WVMT-18-G-2	Baetidae	12
WVMT-18-G-2	Cambaridae	2
WVMT-18-G-2	Oligochaeta	5
WVMT-18-G-2	Capniidae/Leuctrid	4
WVMT-22	Psephenidae	2
WVMT-22	Chironomidae	4
WVMT-22	Dixidae	3
WVMT-22	Veliidae	2
WVMT-22	Perlidae	7
WVMT-22	Capniidae/Leuctrid	3

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-22	Cambaridae	1
WVMT-22	Polycentropodidae	2
WVMT-22	Baetidae	2
WVMT-22	Limnephilidae	1
WVMT-22	Hydropsychidae	6
WVMT-22	Leptophlebiidae	4
WVMT-22	Elmidae	3
WVMT-23	Helicopsychidae	1
WVMT-23	Pleuroceridae	7
WVMT-23	Simuliidae	2
WVMT-23	Athericidae	3
WVMT-23	Corydalidae	4
WVMT-23	Psephenidae	21
WVMT-23	Perlidae	5
WVMT-23	Chironomidae	3
WVMT-23	Philopotamidae	18
WVMT-23	Rhyacophilidae	2
WVMT-23	Hydropsychidae	49
WVMT-23	Isonychiidae	19
WVMT-23	Heptageniidae	13
WVMT-23	Caenidae	1
WVMT-23	Baetidae	48
WVMT-23	Elmidae	67
WVMT-23-B-1	Corydalidae	1
WVMT-23-B-1	Chironomidae	1
WVMT-23-B-1	Tipulidae	4
WVMT-23-B-1	Sialidae	1
WVMT-23-B-1	Psephenidae	9
WVMT-23-B-1	Elmidae	42
WVMT-23-B-1	Perlidae	4
WVMT-23-B-1	Chloroperlidae	1
WVMT-23-B-1	Hydropsychidae	11
WVMT-23-B-1	Heptageniidae	2
WVMT-23-B-1	Cambaridae	2
WVMT-23-B-1	Baetidae	13
WVMT-23-C-{5.6}	Perlidae	3
WVMT-23-C-{5.6}	Baetidae	9
WVMT-23-C-{5.6}	Chironomidae	12
WVMT-23-C-{5.6}	Tipulidae	2
WVMT-23-C-{5.6}	Pteronarcyidae	1
WVMT-23-C-{5.6}	Hydropsychidae	15
WVMT-23-C-{5.6}	Isonychiidae	59
WVMT-23-C-{5.6}	Leptophlebiidae	16
WVMT-23-C-{5.6}	Oligochaeta	1
WVMT-23-C-{5.6}	Philopotamidae	5
WVMT-23-C-{5.6}	Cambaridae	1
WVMT-23-C-{5.6}	Heptageniidae	4
WVMT-23-C-{5.6}	Ephemerellidae	10
WVMT-23-F	Elmidae	1
WVMT-23-F	Chironomidae	16
WVMT-23-F	Simuliidae	4
WVMT-23-F	Veliidae	1
WVMT-23-F	Aeshnidae	1
WVMT-23-F	Perlidae	6
WVMT-23-F	Philopotamidae	16
WVMT-23-F	Hydropsychidae	17
WVMT-23-F	Leptophlebiidae	1
WVMT-23-F	Heptageniidae	25
WVMT-23-F	Baetidae	15
WVMT-23-F	Tipulidae	1
WVMT-24-{0.03}	Baetidae	43
WVMT-24-{0.03}	Psephenidae	4
WVMT-24-{0.03}	Chironomidae	11
WVMT-24-{0.03}	Simuliidae	2
WVMT-24-{0.03}	Corydalidae	4
WVMT-24-{0.03}	Elmidae	10
WVMT-24-{0.03}	Dryopidae	2
WVMT-24-{0.03}	Perlidae	4
WVMT-24-{0.03}	Philopotamidae	17
WVMT-24-{0.03}	Hydropsychidae	20
WVMT-24-{0.03}	Tricorythidae	1
WVMT-24-{0.03}	Caenidae	4
WVMT-24-{0.03}	Pleuroceridae	4
WVMT-24-{0.03}	Heptageniidae	12
WVMT-24-A	Tabanidae	1
WVMT-24-A	Philopotamidae	5
WVMT-24-A	Chironomidae	62
WVMT-24-A	Empididae	1
WVMT-24-A	Tipulidae	5
WVMT-24-A	Hydropsychidae	113
WVMT-24-A	Calopterygidae	1
WVMT-24-A	Corydalidae	3
WVMT-24-A	Elmidae	4
WVMT-24-A	Simuliidae	2
WVMT-24-C	Dryopidae	3
WVMT-24-C	Chironomidae	9
WVMT-24-C	Simuliidae	3
WVMT-24-C	Tipulidae	1
WVMT-24-C	Gerridae	1
WVMT-24-C	Corydalidae	4
WVMT-24-C	Elmidae	2
WVMT-24-C	Aeshnidae	2
WVMT-24-C	Helicopsychidae	2
WVMT-24-C	Philopotamidae	3
WVMT-24-C	Hydropsychidae	35
WVMT-24-C	Isonychiidae	1
WVMT-24-C	Heptageniidae	15
WVMT-24-C	Baetidae	14
WVMT-24-C	Corbiculidae	25
WVMT-24-C	Oligochaeta	2
WVMT-24-C	Psephenidae	1
WVMT-24-C-1.5-A	Culicidae	1
WVMT-24-C-1.5-A	Cordulegastridae	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-24-C-1.5-A	Simuliidae	1
WVMT-24-C-1.5-A	Curculionidae	1
WVMT-24-C-1.5-A	Aeshnidae	1
WVMT-24-C-1.5-A	Gerridae	2
WVMT-24-C-1.5-A	Cambaridae	2
WVMT-24-C-1.5-A	Calopterygidae	1
WVMT-24-C-1.5-A	Heptageniidae	1
WVMT-24-C-1.5-A	Hydropsychidae	1
WVMT-24-C-2	Tipulidae	19
WVMT-24-C-2	Chironomidae	30
WVMT-24-C-2	Simuliidae	2
WVMT-24-C-2	Elmidae	30
WVMT-24-C-2	Dryopidae	2
WVMT-24-C-2	Hydroptilidae	1
WVMT-24-C-2	Hydropsychidae	14
WVMT-24-C-2	Isonychiidae	3
WVMT-24-C-2	Heptageniidae	21
WVMT-24-C-2	Baetidae	5
WVMT-24-C-2	Tabanidae	1
WVMT-24-C-3.5	Heptageniidae	20
WVMT-24-C-3.5	Veliidae	4
WVMT-24-C-3.5	Chironomidae	5
WVMT-24-C-3.5	Tipulidae	11
WVMT-24-C-3.5	Corydalidae	2
WVMT-24-C-3.5	Elmidae	3
WVMT-24-C-3.5	Dryopidae	1
WVMT-24-C-3.5	Hydropsychidae	16
WVMT-24-C-3.5	Ephemeridae	1
WVMT-24-C-3.5	Baetidae	1
WVMT-24-C-3.5	Perlidae	6
WVMT-26-{0.4}	Veliidae	1
WVMT-26-{0.4}	Philopotamidae	4
WVMT-26-{0.4}	Chironomidae	33
WVMT-26-{0.4}	Simuliidae	3
WVMT-26-{0.4}	Tipulidae	1
WVMT-26-{0.4}	Hydropsychidae	59
WVMT-26-{0.4}	Hydrophilidae	1
WVMT-26-{0.4}	Elmidae	2
WVMT-26-{0.4}	Corbiculidae	1
WVMT-26-{0.4}	Polycentropodidae	4
WVMT-26-{0.4}	Lymnaeidae	1
WVMT-26-{0.4}	Planorbidae	7
WVMT-26-{0.4}	Calopterygidae	1
WVMT-26-{0.4}	Corydalidae	4
WVMT-26-B	Tabanidae	1
WVMT-26-B	Ceratopogonidae	1
WVMT-26-B	Tipulidae	1
WVMT-26-B	Corydalidae	2
WVMT-26-B	Elmidae	14
WVMT-26-B	Hydropsychidae	29
WVMT-26-B	Baetidae	1
WVMT-26-B	Oligochaeta	2
WVMT-26-B	Chironomidae	68
WVMT-26-C	Hydrophilidae	2
WVMT-26-C	Chironomidae	29
WVMT-26-C	Tabanidae	1
WVMT-26-C	Simuliidae	4
WVMT-26-C	Empididae	3
WVMT-26-C	Pyralidae	1
WVMT-26-C	Sialidae	1
WVMT-26-C	Hydrochidae	1
WVMT-26-C	Planorbidae	2
WVMT-26-C	Coenagrionidae	6
WVMT-26-C	Sphaeriidae	2
WVMT-26-C	Lymnaeidae	3
WVMT-26-C	Physidae	15
WVMT-26-C	Elmidae	1
WVMT-26-C	Baetidae	1
WVMT-26-C	Caenidae	1
WVMT-26-C	Phryganeidae	1
WVMT-26-C	Aeshnidae	1
WVMT-26-C	Gomphidae	2
WVMT-26-C	Calopterygidae	5
WVMT-26-C	Oligochaeta	7
WVMT-29	Simuliidae	1
WVMT-29	Tipulidae	2
WVMT-29	Chironomidae	48
WVMT-29	Calopterygidae	1
WVMT-29	Aeshnidae	1
WVMT-29	Hydropsychidae	10
WVMT-29	Oligochaeta	7
WVMT-29	Baetidae	30
WVMT-29	Ephemerellidae	1
WVMT-29	Elmidae	1
WVMT-29	Psychodidae	1
WVMT-31-{6.6}	Coenagrionidae	2
WVMT-31-{6.6}	Chironomidae	7
WVMT-31-{6.6}	Gerridae	1
WVMT-31-{6.6}	Dreissena	1
WVMT-31-{6.6}	Hydrophilidae	1
WVMT-31-{6.6}	Corduliidae	2
WVMT-31-{6.6}	Gomphidae	1
WVMT-31-{6.6}	Polycentropodidae	4
WVMT-31-{6.6}	Heptageniidae	1
WVMT-31-{6.6}	Collembola	5
WVMT-31-{6.6}	Oligochaeta	1
WVMT-31-{6.6}	Elmidae	18
WVMTB-1	Corydalidae	3
WVMTB-1	Tipulidae	17
WVMTB-1	Cambaridae	1
WVMTB-1	Baetidae	8
WVMTB-1	Heptageniidae	47

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTB-1	Hydropsychidae	12
WVMTB-1	Philopotamidae	13
WVMTB-1	Capniidae/Leuctrid	1
WVMTB-1	Elmidae	34
WVMTB-1	Psephenidae	1
WVMTB-1	Chironomidae	5
WVMTB-5	Sialidae	1
WVMTB-5	Hydrophilidae	1
WVMTB-5	Elmidae	60
WVMTB-5	Polycentropodidae	4
WVMTB-5	Philopotamidae	18
WVMTB-5	Hydropsychidae	83
WVMTB-5	Asellidae	1
WVMTB-5	Heptageniidae	1
WVMTB-5	Veliidae	1
WVMTB-5	Isonychiidae	6
WVMTB-5	Ceratopogonidae	2
WVMTB-5	Simuliidae	35
WVMTB-5	Chironomidae	35
WVMTB-5	Cambaridae	1
WVMTB-5	Baetidae	253
WVMTB-5	Tipulidae	11
WVMTB-5	Corydalidae	5
WVMTB-5-B	Coenagrionidae	18
WVMTB-5-B	Tabanidae	1
WVMTB-5-B	Chironomidae	3
WVMTB-5-B	Hydrophilidae	1
WVMTB-5-B	Haliplidae	2
WVMTB-5-B	Elmidae	4
WVMTB-5-B	Corduliidae	1
WVMTB-5-B	Calopterygidae	2
WVMTB-5-B	Libellulidae	1
WVMTB-5-B	Aeshnidae	2
WVMTB-5-B	Planorbidae	89
WVMTB-5-B	Physidae	9
WVMTB-5-B	Sphaeriidae	8
WVMTB-5-C	Calopterygidae	7
WVMTB-5-C	Oligochaeta	11
WVMTB-5-C	Chironomidae	17
WVMTB-5-C	Hydropsychidae	3
WVMTB-5-C	Ephemerellidae	2
WVMTB-5-C	Hydrophilidae	2
WVMTB-5-C	Tipulidae	11
WVMTB-5-C	Empididae	1
WVMTB-5-C	Tabanidae	56
WVMTB-7-{1.0}	Elmidae	61
WVMTB-7-{1.0}	Corydalidae	5
WVMTB-7-{1.0}	Veliidae	1
WVMTB-7-{1.0}	Tipulidae	7
WVMTB-7-{1.0}	Empididae	1
WVMTB-7-{1.0}	Chloroperlidae	9
WVMTB-7-{1.0}	Chironomidae	16
WVMTB-7-{1.0}	Philopotamidae	14
WVMTB-7-{1.0}	Simuliidae	3
WVMTB-7-{1.0}	Baetidae	35
WVMTB-7-{1.0}	Perlidae	3
WVMTB-7-{1.0}	Nematoda	1
WVMTB-7-{1.0}	Caenidae	2
WVMTB-7-{1.0}	Heptageniidae	53
WVMTB-7-{1.0}	Isonychiidae	37
WVMTB-7-{1.0}	Hydropsychidae	87
WVMTB-7-{1.0}	Hydroptilidae	1
WVMTB-7-A-{0.5}	Ephemeridae	1
WVMTB-7-A-{0.5}	Polycentropodidae	1
WVMTB-7-A-{0.5}	Simuliidae	2
WVMTB-7-A-{0.5}	Tipulidae	2
WVMTB-7-A-{0.5}	Sialidae	1
WVMTB-7-A-{0.5}	Gomphidae	1
WVMTB-7-A-{0.5}	Perlidae	1
WVMTB-7-A-{0.5}	Chironomidae	74
WVMTB-7-A-{0.5}	Philopotamidae	21
WVMTB-7-A-{0.5}	Baetidae	77
WVMTB-7-A-{0.5}	Rhyacophilidae	1
WVMTB-7-A-{0.5}	Heptageniidae	4
WVMTB-7-A-{0.5}	Limnephilidae	1
WVMTB-7-A-{0.5}	Hydropsychidae	35
WVMTB-7-A-{2.9}	Elmidae	6
WVMTB-7-A-{2.9}	Baetidae	12
WVMTB-7-A-{2.9}	Heptageniidae	5
WVMTB-7-A-{2.9}	Hydropsychidae	15
WVMTB-7-A-{2.9}	Polycentropodidae	2
WVMTB-7-A-{2.9}	Capniidae/Leuctrid	9
WVMTB-7-A-{2.9}	Perlidae	9
WVMTB-7-A-{2.9}	Aeshnidae	3
WVMTB-7-A-{2.9}	Dryopidae	3
WVMTB-7-A-{2.9}	Sialidae	1
WVMTB-7-A-{2.9}	Oligochaeta	3
WVMTB-7-A-{2.9}	Tipulidae	5
WVMTB-7-A-{2.9}	Simuliidae	1
WVMTB-7-A-{2.9}	Tabanidae	1
WVMTB-7-A-{2.9}	Chironomidae	36
WVMTB-7-A-{2.9}	Cambaridae	4
WVMTB-7-C-{0.32}	Elmidae	4
WVMTB-7-C-{0.32}	Tabanidae	2
WVMTB-7-C-{0.32}	Tipulidae	12
WVMTB-7-C-{0.32}	Psephenidae	1
WVMTB-7-C-{0.32}	Perlidae	2
WVMTB-7-C-{0.32}	Limnephilidae	2
WVMTB-7-C-{0.32}	Rhyacophilidae	3
WVMTB-7-C-{0.32}	Hydropsychidae	23
WVMTB-7-C-{0.32}	Leptophlebiidae	1
WVMTB-7-C-{0.32}	Heptageniidae	14
WVMTB-7-C-{0.32}	Ephemerellidae	10

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTB-7-C-{0.32}	Baetidae	4
WVMTB-7-C-{0.32}	Cambaridae	3
WVMTB-7-C-{0.32}	Chironomidae	6
WVMTB-7-C-{0.32}	Sialidae	1
WVMTB-8	Sialidae	2
WVMTB-8	Cambaridae	1
WVMTB-8	Baetidae	32
WVMTB-8	Tabanidae	2
WVMTB-8	Corydalidae	2
WVMTB-8	Elmidae	36
WVMTB-8	Heptageniidae	1
WVMTB-8	Chironomidae	28
WVMTB-8	Hydropsychidae	58
WVMTB-8	Capniidae/Leuctrid	1
WVMTB-9	Empididae	3
WVMTB-9	Chironomidae	56
WVMTB-9	Veliidae	2
WVMTB-9	Baetidae	6
WVMTB-9	Ceratopogonidae	2
WVMTB-9	Leptophlebiidae	1
WVMTB-9	Simuliidae	5
WVMTB-9	Oligochaeta	4
WVMTB-9	Caenidae	1
WVMTB-9	Heptageniidae	1
WVMTB-9	Elmidae	10
WVMTB-9	Calopterygidae	2
WVMTB-9	Philopotamidae	1
WVMTB-9	Hydropsychidae	9
WVMTB-9	Tipulidae	8
WVMTB-10-A	Elmidae	2
WVMTB-10-A	Hydropsychidae	14
WVMTB-10-A	Chironomidae	81
WVMTB-10-A	Empididae	4
WVMTB-10-A	Ceratopogonidae	3
WVMTB-10-A	Tipulidae	3
WVMTB-10-A	Caenidae	1
WVMTB-10-A	Hydrophilidae	1
WVMTB-11	Chironomidae	57
WVMTB-11	Tabanidae	1
WVMTB-11	Oligochaeta	25
WVMTB-11	Hydropsychidae	50
WVMTB-11	Philopotamidae	3
WVMTB-11	Elmidae	8
WVMTB-11	Tipulidae	1
WVMTB-11	Ceratopogonidae	1
WVMTB-11	Empididae	1
WVMTB-11	Simuliidae	3
WVMTB-11-B	Oligochaeta	20
WVMTB-11-B	Chironomidae	5
WVMTB-11-B	Elmidae	1
WVMTB-11-B	Tabanidae	1
WVMTB-11-B.5	Aeshnidae	1
WVMTB-11-B.5	Stratiomyidae	1
WVMTB-11-B.5	Chironomidae	94
WVMTB-11-B.5	Tabanidae	8
WVMTB-11-B.5	Tipulidae	1
WVMTB-11-B.5	Calopterygidae	4
WVMTB-11-B.5	Hydropsychidae	4
WVMTB-11-B.5	Baetidae	1
WVMTB-11-B.5	Oligochaeta	26
WVMTB-11-B.5	Elmidae	2
WVMTB-18-{11.2}	Dytiscidae	1
WVMTB-18-{11.2}	Chironomidae	53
WVMTB-18-{11.2}	Tabanidae	10
WVMTB-18-{11.2}	Corydalidae	1
WVMTB-18-{11.2}	Phryganeidae	1
WVMTB-18-{11.2}	Elmidae	13
WVMTB-18-{11.2}	Dryopidae	1
WVMTB-18-{11.2}	Coenagrionidae	2
WVMTB-18-{11.2}	Calopterygidae	4
WVMTB-18-{11.2}	Aeshnidae	1
WVMTB-18-{11.2}	Polycentropodidae	2
WVMTB-18-{11.2}	Hydropsychidae	6
WVMTB-18-{11.2}	Leptophlebiidae	1
WVMTB-18-{11.2}	Heptageniidae	24
WVMTB-18-{11.2}	Caenidae	7
WVMTB-18-{11.2}	Baetidae	4
WVMTB-18-{11.2}	Gomphidae	1
WVMTB-18-B	Tabanidae	1
WVMTB-18-B	Chironomidae	17
WVMTB-18-B	Simuliidae	2
WVMTB-18-B	Empididae	3
WVMTB-18-B	Corydalidae	1
WVMTB-18-B	Elmidae	15
WVMTB-18-B	Limnephilidae	1
WVMTB-18-B	Hydropsychidae	95
WVMTB-18-B	Sphaeriidae	1
WVMTB-18-B	Oligochaeta	1
WVMTB-18-B	Caenidae	1
WVMTB-18-B-2	Chironomidae	7
WVMTB-18-B-2	Planorbidae	14
WVMTB-18-B-3	Hydropsychidae	3
WVMTB-18-B-3	Tipulidae	3
WVMTB-18-B-3	Ceratopogonidae	1
WVMTB-18-B-3	Psephenidae	1
WVMTB-18-B-3	Hydrophilidae	2
WVMTB-18-B-3	Elmidae	2
WVMTB-18-B-3	Calopterygidae	5
WVMTB-18-B-3	Phryganeidae	1
WVMTB-18-B-3	Tabanidae	7
WVMTB-18-B-3	Gomphidae	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTB-18-B-3	Chironomidae	65
WVMTB-18-B-3	Planorbidae	2
WVMTB-18-B-3	Empididae	3
WVMTB-18-B-3	Oligochaeta	3
WVMTB-18-B-3	Sphaeriidae	8
WVMTB-18-B-3	Physidae	3
WVMTB-18-B-3	Stratiomyidae	1
WVMTB-18-D-{3.9}	Aeshnidae	1
WVMTB-18-D-{3.9}	Dryopidae	4
WVMTB-18-D-{3.9}	Chironomidae	11
WVMTB-18-D-{3.9}	Tabanidae	1
WVMTB-18-D-{3.9}	Tipulidae	2
WVMTB-18-D-{3.9}	Veliidae	1
WVMTB-18-D-{3.9}	Corydalidae	3
WVMTB-18-D-{3.9}	Elmidae	6
WVMTB-18-D-{3.9}	Heptageniidae	21
WVMTB-18-D-{3.9}	Capniidae/Leuctrid	1
WVMTB-18-D-{3.9}	Polycentropodidae	1
WVMTB-18-D-{3.9}	Philopotamidae	4
WVMTB-18-D-{3.9}	Rhyacophilidae	3
WVMTB-18-D-{3.9}	Hydropsychidae	46
WVMTB-18-D-{3.9}	Leptophlebiidae	1
WVMTB-18-D-{3.9}	Cambaridae	1
WVMTB-18-D-{3.9}	Baetidae	3
WVMTB-18-D-{3.9}	Psephenidae	2
WVMTB-18-D-{3.9}	Perlidae	2
WVMTB-19-{0.9}	Calopterygidae	3
WVMTB-19-{0.9}	Dryopidae	3
WVMTB-19-{0.9}	Elmidae	13
WVMTB-19-{0.9}	Psephenidae	5
WVMTB-19-{0.9}	Gomphidae	1
WVMTB-19-{0.9}	Saldidae	1
WVMTB-19-{0.9}	Tipulidae	16
WVMTB-19-{0.9}	Chironomidae	12
WVMTB-19-{0.9}	Veliidae	16
WVMTB-19-{0.9}	Polycentropodidae	1
WVMTB-19-{0.9}	Limnephilidae	1
WVMTB-19-{0.9}	Philopotamidae	7
WVMTB-19-{0.9}	Rhyacophilidae	2
WVMTB-19-{0.9}	Hydropsychidae	40
WVMTB-19-{0.9}	Heptageniidae	3
WVMTB-19-{0.9}	Ephemerellidae	1
WVMTB-19-{0.9}	Baetidae	1
WVMTB-19-{0.9}	Asellidae	2
WVMTB-19-{0.9}	Tabanidae	4
WVMTB-19-{0.9}	Corydalidae	3
WVMTB-19-{0.9}	Aeshnidae	2
WVMTB-20	Baetidae	1
WVMTB-20	Chironomidae	7
WVMTB-20	Simuliidae	12
WVMTB-20	Hydropsychidae	84
WVMTB-20	Philopotamidae	2
WVMTB-24	Hydropsychidae	85
WVMTB-24	Heptageniidae	14
WVMTB-24	Chironomidae	7
WVMTB-24	Tabanidae	1
WVMTB-24	Tipulidae	8
WVMTB-24	Philopotamidae	2
WVMTB-25	Corydalidae	1
WVMTB-25	Hydropsychidae	44
WVMTB-25	Dryopidae	1
WVMTB-25	Corixidae	1
WVMTB-25	Pyralidae	1
WVMTB-25	Tipulidae	2
WVMTB-25	Chironomidae	14
WVMTB-25	Philopotamidae	2
WVMTB-25-A	Philopotamidae	2
WVMTB-25-A	Corydalidae	2
WVMTB-25-A	Hydropsychidae	17
WVMTB-25-A	Psychodidae	1
WVMTB-25-A	Chironomidae	24
WVMTB-25-A	Cambaridae	3
WVMTB-25-A	Veliidae	1
WVMTB-25-A	Elmidae	1
WVMTB-25-A	Perlodidae	4
WVMTB-25-A	Chloroperlidae	12
WVMTB-25-A	Capniidae/Leuctrid	3
WVMTB-25-A	Rhyacophilidae	5
WVMTB-25-A	Heptageniidae	7
WVMTB-25-A	Ephemerellidae	1
WVMTB-25-A	Baetidae	2
WVMTB-25-A	Tipulidae	6
WVMTB-27	Corydalidae	1
WVMTB-27	Chironomidae	38
WVMTB-27	Simuliidae	1
WVMTB-27	Empididae	1
WVMTB-27	Tipulidae	1
WVMTB-27	Capniidae/Leuctrid	7
WVMTB-27	Philopotamidae	10
WVMTB-27	Rhyacophilidae	4
WVMTB-27	Hydropsychidae	38
WVMTB-27	Ephemerellidae	1
WVMTB-27	Cambaridae	2
WVMTB-27	Ceratopogonidae	1
WVMTB-27	Perlidae	2
WVMTB-28	Baetidae	25
WVMTB-28	Philopotamidae	11
WVMTB-28	Rhyacophilidae	1
WVMTB-28	Hydropsychidae	24
WVMTB-28	Polycentropodidae	1
WVMTB-28	Heptageniidae	8
WVMTB-28	Tipulidae	3

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTB-28	Leptophlebiidae	1
WVMTB-28	Capniidae/Leuctrid	1
WVMTB-28	Perlidae	3
WVMTB-28	Psephenidae	1
WVMTB-28	Empididae	3
WVMTB-28	Simuliidae	26
WVMTB-28	Chironomidae	97
WVMTB-28	Elmidae	2
WVMTB-28	Perlodidae	2
WVMTB-28	Veliidae	4
WVMTB-30	Corydalidae	4
WVMTB-30	Oligochaeta	4
WVMTB-30	Chironomidae	14
WVMTB-30	Tipulidae	1
WVMTB-30	Veliidae	1
WVMTB-30	Elmidae	1
WVMTB-30	Gomphidae	2
WVMTB-30	Peltoperlidae	1
WVMTB-30	Chloroperlidae	12
WVMTB-30	Capniidae/Leuctrid	12
WVMTB-30	Rhyacophilidae	1
WVMTB-30	Hydropsychidae	55
WVMTB-30	Asellidae	1
WVMTB-30	Pyralidae	1
WVMTB-31	Corydalidae	5
WVMTB-31	Perlidae	9
WVMTB-31	Chironomidae	31
WVMTB-31	Simuliidae	6
WVMTB-31	Veliidae	1
WVMTB-31	Elmidae	18
WVMTB-31	Leptoceridae	1
WVMTB-31	Philopotamidae	5
WVMTB-31	Baetidae	17
WVMTB-31	Hydropsychidae	117
WVMTB-31	Ephemerellidae	1
WVMTB-31	Isonychiidae	2
WVMTB-31	Heptageniidae	19
WVMTB-31	Tipulidae	2
WVMTB-31	Polycentropodidae	2
WVMTB-31-C	Capniidae/Leuctrid	17
WVMTB-31-C	Chironomidae	4
WVMTB-31-C	Tipulidae	1
WVMTB-31-C	Corydalidae	1
WVMTB-31-C	Elmidae	1
WVMTB-31-C	Perlodidae	19
WVMTB-31-C	Chloroperlidae	1
WVMTB-31-C	Philopotamidae	1
WVMTB-31-C	Rhyacophilidae	5
WVMTB-31-C	Hydropsychidae	67
WVMTB-31-C	Heptageniidae	1
WVMTB-31-C	Cambaridae	1
WVMTB-31-C	Oligochaeta	2
WVMTB-31-C	Peltoperlidae	8
WVMTB-31-D	Capniidae/Leuctrid	1
WVMTB-31-D	Rhyacophilidae	2
WVMTB-31-D	Chironomidae	24
WVMTB-31-D	Tipulidae	2
WVMTB-31-D	Pyralidae	1
WVMTB-31-D	Pteronarcyidae	2
WVMTB-31-D	Perlidae	6
WVMTB-31-D	Philopotamidae	17
WVMTB-31-D	Baetidae	12
WVMTB-31-D	Hydropsychidae	40
WVMTB-31-D	Glossosomatidae	1
WVMTB-31-D	Heptageniidae	6
WVMTB-31-D	Polycentropodidae	1
WVMTB-31-D	Ephemerellidae	1
WVMTB-31-F-1	Pteronarcyidae	1
WVMTB-31-F-1	Chironomidae	33
WVMTB-31-F-1	Ceratopogonidae	1
WVMTB-31-F-1	Tipulidae	5
WVMTB-31-F-1	Veliidae	3
WVMTB-31-F-1	Elmidae	6
WVMTB-31-F-1	Ephemerellidae	1
WVMTB-31-F-1	Philopotamidae	8
WVMTB-31-F-1	Rhyacophilidae	3
WVMTB-31-F-1	Hydropsychidae	52
WVMTB-31-F-1	Leptophlebiidae	2
WVMTB-31-F-1	Heptageniidae	9
WVMTB-31-F-1	Perlidae	4
WVMTB-31-F-1	Corydalidae	1
WVMTB-31-F-1	Baetidae	6
WVMTB-31-F-2-{0.8}	Perlodidae	1
WVMTB-31-F-2-{0.8}	Elmidae	3
WVMTB-31-F-2-{0.8}	Corydalidae	1
WVMTB-31-F-2-{0.8}	Tipulidae	1
WVMTB-31-F-2-{0.8}	Ceratopogonidae	1
WVMTB-31-F-2-{0.8}	Chironomidae	15
WVMTB-31-F-2-{0.8}	Pteronarcyidae	1
WVMTB-31-F-2-{0.8}	Baetidae	13
WVMTB-31-F-2-{0.8}	Simuliidae	1
WVMTB-31-F-2-{0.8}	Chloroperlidae	1
WVMTB-31-F-2-{0.8}	Capniidae/Leuctrid	4
WVMTB-31-F-2-{0.8}	Philopotamidae	10
WVMTB-31-F-2-{0.8}	Rhyacophilidae	2
WVMTB-31-F-2-{0.8}	Hydroptilidae	48
WVMTB-31-F-2-{0.8}	Heptageniidae	2
WVMTB-31-F-2-{0.8}	Perlidae	2
WVMTB-31-F-2-{0.8}	Leptophlebiidae	1
WVMTB-31-F-2-{0.8}	Cambaridae	1
WVMTB-31-F-5	Chloroperlidae	3
WVMTB-31-F-5	Empididae	2
WVMTB-31-F-5	Peltoperlidae	1
WVMTB-31-F-5	Perlodidae	11
WVMTB-31-F-5	Elmidae	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTB-31-F-5	Chironomidae	9
WVMTB-31-F-5	Tipulidae	2
WVMTB-31-F-5	Polycentropodidae	1
WVMTB-31-F-5	Leptophlebiidae	1
WVMTB-31-F-5	Philopotamidae	3
WVMTB-31-F-5	Rhyacophilidae	2
WVMTB-31-F-5	Heptageniidae	3
WVMTB-31-F-5	Baetidae	3
WVMTB-31-F-5	Capniidae/Leuctrid	4
WVMTB-31-F-5	Hydropsychidae	49
WVMTB-31-J	Capniidae/Leuctrid	3
WVMTB-31-J	Chironomidae	11
WVMTB-31-J	Simuliidae	1
WVMTB-31-J	Psephenidae	3
WVMTB-31-J	Elmidae	1
WVMTB-31-J	Chloroperlidae	1
WVMTB-31-J	Pyralidae	10
WVMTB-31-J	Philopotamidae	2
WVMTB-31-J	Rhyacophilidae	2
WVMTB-31-J	Hydropsychidae	42
WVMTB-31-J	Leptophlebiidae	1
WVMTB-31-J	Heptageniidae	27
WVMTB-31-J	Baetidae	3
WVMTB-31-J	Perlidae	5
WVMTB-31-J	Tipulidae	1
WVMTB-32-{0.4} (9/8/97)	Psephenidae	1
WVMTB-32-{0.4}	Chironomidae	46
WVMTB-32-{0.4}	Chloroperlidae	2
WVMTB-32-{0.4}	Tipulidae	3
WVMTB-32-{0.4}	Elmidae	4
WVMTB-32-{0.4}	Perlidae	5
WVMTB-32-{0.4}	Ephemerellidae	2
WVMTB-32-{0.4}	Heptageniidae	30
WVMTB-32-{0.4}	Baetidae	111
WVMTB-32-{0.4}	Isonychiidae	1
WVMTB-32-{0.4}	Glossosomatidae	1
WVMTB-32-{0.4}	Hydropsychidae	41
WVMTB-32-{0.4}	Philopotamidae	36
WVMTB-32-{0.4}	Simuliidae	9
WVMTB-32-{0.4} (9/16/97)	Elmidae	4
WVMTB-32-{0.4}	Baetidae	19
WVMTB-32-{0.4}	Heptageniidae	25
WVMTB-32-{0.4}	Isonychiidae	3
WVMTB-32-{0.4}	Hydropsychidae	26
WVMTB-32-{0.4}	Philopotamidae	22
WVMTB-32-{0.4}	Chloroperlidae	1
WVMTB-32-{0.4}	Psephenidae	1
WVMTB-32-{0.4}	Corydalidae	1
WVMTB-32-{0.4}	Veliidae	2
WVMTB-32-{0.4}	Simuliidae	2
WVMTB-32-{0.4}	Chironomidae	21
WVMTB-32-{0.4}	Perlidae	7
WVMTB-32-D	Perlodidae	1
WVMTB-32-D	Heptageniidae	8
WVMTB-32-D	Hydropsychidae	31
WVMTB-32-D	Rhyacophilidae	1
WVMTB-32-D	Philopotamidae	3
WVMTB-32-D	Dixidae	2
WVMTB-32-D	Chironomidae	29
WVMTB-32-D	Ceratopogonidae	1
WVMTB-32-D	Perlidae	1
WVMTB-32-D	Pyralidae	2
WVMTB-32-D	Baetidae	9
WVMTB-32-D	Cambaridae	2
WVMTB-32-D	Tipulidae	1
WVMTB-32-H	Philopotamidae	26
WVMTB-32-H	Curculionidae	1
WVMTB-32-H	Oligochaeta	1
WVMTB-32-H	Baetidae	43
WVMTB-32-H	Heptageniidae	4
WVMTB-32-H	Rhyacophilidae	9
WVMTB-32-H	Capniidae/Leuctrid	5
WVMTB-32-H	Chloroperlidae	2
WVMTB-32-H	Peltoperlidae	1
WVMTB-32-H	Pteronarcyidae	1
WVMTB-32-H	Chironomidae	51
WVMTB-32-H	Simuliidae	30
WVMTB-32-H	Empididae	1
WVMTB-32-H	Hydropsychidae	40
WVMTB-32-I-1	Capniidae/Leuctrid	9
WVMTB-32-I-1	Perlodidae	5
WVMTB-32-I-1	Baetidae	13
WVMTB-32-I-1	Ameletidae	7
WVMTB-32-I-1	Rhyacophilidae	21
WVMTB-32-I-1	Chloroperlidae	25
WVMTB-32-I-1	Peltoperlidae	2
WVMTB-32-I-1	Simuliidae	1
WVMTB-32-I-1	Chironomidae	17
WVMTB-32-I-1	Hydropsychidae	4
WVMTB-32-I-1	Tipulidae	8
WVMT-33-{11.8}	Philopotamidae	1
WVMT-33-{11.8}	Caenidae	1
WVMT-33-{11.8}	Heptageniidae	28
WVMT-33-{11.8}	Hydropsychidae	47
WVMT-33-{11.8}	Baetidae	3
WVMT-33-{11.8}	Elmidae	6
WVMT-33-{11.8}	Chironomidae	4
WVMT-33-{11.8}	Corydalidae	8
WVMT-33-{11.8}	Simuliidae	54
WVMT-33-{11.8}	Isonychiidae	17
WVMTM-0.5-{0.6}	Tipulidae	15
WVMTM-0.5-{0.6}	Tabanidae	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTM-0.5-{0.6}	Ceratopogonidae	1
WVMTM-0.5-{0.6}	Chironomidae	10
WVMTM-0.5-{0.6}	Sialidae	4
WVMTM-0.5-{0.6}	Psephenidae	2
WVMTM-0.5-{0.6}	Elmidae	7
WVMTM-0.5-{0.6}	Cordulegastridae	1
WVMTM-0.5-{0.6}	Perlidae	1
WVMTM-0.5-{0.6}	Polycentropodidae	1
WVMTM-0.5-{0.6}	Rhyacophilidae	3
WVMTM-0.5-{0.6}	Hydropsychidae	4
WVMTM-0.5-{0.6}	Heptageniidae	4
WVMTM-0.5-{0.6}	Baetidae	1
WVMTM-0.5-{0.6}	Asellidae	1
WVMTM-0.5-{0.6}	Cambaridae	7
WVMTM-0.5-{0.6}	Corydalidae	6
WVMTM-0.5-{0.6}	Ephemerellidae	13
WVMTM-1	Ephemeridae	1
WVMTM-1	Cambaridae	1
WVMTM-1	Heptageniidae	10
WVMTM-1	Hydroptilidae	45
WVMTM-1	Philopotamidae	31
WVMTM-1	Capniidae/Leuctrid	7
WVMTM-1	Chloroperlidae	2
WVMTM-1	Perlidae	10
WVMTM-1	Simuliidae	2
WVMTM-1	Oligochaeta	1
WVMTM-1	Elmidae	11
WVMTM-1	Chironomidae	19
WVMTM-1	Empididae	2
WVMTM-1	Ceratopogonidae	2
WVMTM-1	Tipulidae	11
WVMTM-1	Veliidae	1
WVMTM-1	Corydalidae	5
WVMTM-2	Peltoperlidae	2
WVMTM-2	Asellidae	1
WVMTM-2	Philopotamidae	1
WVMTM-2	Capniidae/Leuctrid	3
WVMTM-2	Polycentropodidae	2
WVMTM-2	Limnephilidae	1
WVMTM-2	Chloroperlidae	3
WVMTM-2	Rhyacophilidae	1
WVMTM-2	Hydropsychidae	25
WVMTM-2	Leptophlebiidae	3
WVMTM-2	Ephemerellidae	1
WVMTM-2	Perlidae	1
WVMTM-2	Baetidae	1
WVMTM-2	Heptageniidae	11
WVMTM-2	Elmidae	10
WVMTM-2	Corydalidae	10
WVMTM-2	Veliidae	1
WVMTM-2	Tipulidae	17
WVMTM-2	Empididae	3
WVMTM-2	Chironomidae	19
WVMTM-2	Cambaridae	2
WVMTM-2	Gomphidae	1
WVMTM-3	Hydropsychidae	4
WVMTM-3	Chironomidae	3
WVMTM-3	Polymitarcyidae	2
WVMTM-5	Rhyacophilidae	4
WVMTM-5	Corydalidae	9
WVMTM-5	Chloroperlidae	1
WVMTM-5	Nemouridae	3
WVMTM-5	Tipulidae	3
WVMTM-5	Chironomidae	16
WVMTM-5	Capniidae/Leuctrid	37
WVMTM-5	Limnephilidae	1
WVMTM-5	Haliplidae	1
WVMTM-5	Hydropsychidae	23
WVMTM-5	Ephemerellidae	16
WVMTM-5	Cambaridae	1
WVMTM-5	Elmidae	2
WVMTM-7	Hydropsychidae	72
WVMTM-7	Oligochaeta	1
WVMTM-7	Rhyacophilidae	1
WVMTM-7	Cambaridae	1
WVMTM-7	Peltoperlidae	9
WVMTM-7	Heptageniidae	7
WVMTM-7	Philopotamidae	8
WVMTM-7	Corydalidae	5
WVMTM-7	Hydrophilidae	1
WVMTM-7	Perlodidae	3
WVMTM-7	Chloroperlidae	2
WVMTM-7	Capniidae/Leuctrid	25
WVMTM-7	Simuliidae	1
WVMTM-7	Tabanidae	1
WVMTM-7	Chironomidae	18
WVMTM-7	Tipulidae	5
WVMTM-7	Elmidae	2
WVMTM-7	Polycentropodidae	3
WVMTM-11-{0.3}	Chloroperlidae	2
WVMTM-11-{0.3}	Elmidae	77
WVMTM-11-{0.3}	Corydalidae	10
WVMTM-11-{0.3}	Veliidae	1
WVMTM-11-{0.3}	Simuliidae	10
WVMTM-11-{0.3}	Capniidae/Leuctrid	2
WVMTM-11-{0.3}	Oligochaeta	1
WVMTM-11-{0.3}	Empididae	6
WVMTM-11-{0.3}	Tipulidae	9
WVMTM-11-{0.3}	Philopotamidae	6
WVMTM-11-{0.3}	Rhyacophilidae	2
WVMTM-11-{0.3}	Hydropsychidae	82
WVMTM-11-{0.3}	Isonychiidae	3
WVMTM-11-{0.3}	Leptophlebiidae	1
WVMTM-11-{0.3}	Baetidae	3
WVMTM-11-{0.3}	Chironomidae	33

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTM-11-{0.3}	Psephenidae	2
WVMTM-11-{0.3}	Heptageniidae	16
WVMTM-11-{0.3}	Perlidae	3
WVMTM-11-{7.6}	Capniidae/Leuctrid	4
WVMTM-11-{7.6}	Empididae	1
WVMTM-11-{7.6}	Ceratopogonidae	3
WVMTM-11-{7.6}	Tipulidae	1
WVMTM-11-{7.6}	Veliidae	1
WVMTM-11-{7.6}	Psephenidae	2
WVMTM-11-{7.6}	Chironomidae	8
WVMTM-11-{7.6}	Pteronarcyidae	2
WVMTM-11-{7.6}	Glossosomatidae	3
WVMTM-11-{7.6}	Polycentropodidae	1
WVMTM-11-{7.6}	Philopotamidae	3
WVMTM-11-{7.6}	Rhyacophilidae	10
WVMTM-11-{7.6}	Hydropsychidae	32
WVMTM-11-{7.6}	Leptophlebiidae	4
WVMTM-11-{7.6}	Baetidae	9
WVMTM-11-{7.6}	Cambaridae	2
WVMTM-11-{7.6}	Elmidae	5
WVMTM-11-{7.6}	Heptageniidae	10
WVMTM-11-E	Chloroperlidae	1
WVMTM-11-E	Heptageniidae	16
WVMTM-11-E	Baetidae	1
WVMTM-11-E	Cambaridae	1
WVMTM-11-E	Oligochaeta	1
WVMTM-11-E	Hydropsychidae	78
WVMTM-11-E	Rhyacophilidae	1
WVMTM-11-E	Philopotamidae	5
WVMTM-11-E	Capniidae/Leuctrid	9
WVMTM-11-E	Leptophlebiidae	9
WVMTM-11-E	Perlidae	4
WVMTM-11-E	Elmidae	3
WVMTM-11-E	Corydalidae	1
WVMTM-11-E	Tipulidae	2
WVMTM-11-E	Chironomidae	14
WVMTM-11-E	Polycentropodidae	1
WVMTM-13-{0.8}	Elmidae	7
WVMTM-13-{0.8}	Pteronarcyidae	3
WVMTM-13-{0.8}	Veliidae	1
WVMTM-13-{0.8}	Tipulidae	6
WVMTM-13-{0.8}	Empididae	2
WVMTM-13-{0.8}	Staphylinidae	1
WVMTM-13-{0.8}	Simuliidae	3
WVMTM-13-{0.8}	Chironomidae	14
WVMTM-13-{0.8}	Baetidae	4
WVMTM-13-{0.8}	Hydropsychidae	178
WVMTM-13-{0.8}	Perlidae	10
WVMTM-13-{0.8}	Corydalidae	7
WVMTM-13-{0.8}	Glossosomatidae	2
WVMTM-13-{0.8}	Hydroptilidae	1
WVMTM-13-{0.8}	Rhyacophilidae	3
WVMTM-13-{0.8}	Philopotamidae	27
WVMTM-13-{0.8}	Peltoperlidae	1
WVMTM-13-{0.8}	Heptageniidae	7
WVMTM-17	Empididae	2
WVMTM-17	Hydropsychidae	4
WVMTM-17	Chironomidae	56
WVMTM-17	Tipulidae	15
WVMTM-17	Saldidae	1
WVMTM-17	Veliidae	2
WVMTM-17	Elmidae	11
WVMTM-17	Dryopidae	3
WVMTM-17	Limnephilidae	1
WVMTM-17	Leptophlebiidae	1
WVMTM-17	Ephemerellidae	1
WVMTM-17	Baetidae	1
WVMTM-17	Cambaridae	1
WVMTM-17	Oligochaeta	1
WVMTM-17	Pteronarcyidae	1
WVMTM-21	Pteronarcyidae	1
WVMTM-21	Elmidae	16
WVMTM-21	Chironomidae	27
WVMTM-21	Empididae	1
WVMTM-21	Tipulidae	7
WVMTM-21	Pyralidae	2
WVMTM-21	Veliidae	2
WVMTM-21	Corydalidae	1
WVMTM-21	Haliplidae	1
WVMTM-21	Chloroperlidae	3
WVMTM-21	Capniidae/Leuctrid	2
WVMTM-21	Hydropsychidae	42
WVMTM-21	Baetidae	1
WVMTM-21	Cambaridae	3
WVMTM-21	Oligochaeta	1
WVMTM-25-{1.5}	Philopotamidae	21
WVMTM-25-{1.5}	Tipulidae	14
WVMTM-25-{1.5}	Perlodidae	27
WVMTM-25-{1.5}	Pteronarcyidae	6
WVMTM-25-{1.5}	Chloroperlidae	15
WVMTM-25-{1.5}	Polycentropodidae	4
WVMTM-25-{1.5}	Chironomidae	14
WVMTM-25-{1.5}	Rhyacophilidae	15
WVMTM-25-{1.5}	Hydropsychidae	66
WVMTM-25-{1.5}	Heptageniidae	12
WVMTM-25-{1.5}	Baetidae	5
WVMTM-25-{1.5}	Cambaridae	1
WVMTM-25-{1.5}	Capniidae/Leuctrid	5
WVMTM-25-A	Capniidae/Leuctrid	24
WVMTM-25-A	Tipulidae	6
WVMTM-25-A	Sialidae	1
WVMTM-25-A	Perlodidae	13
WVMTM-25-A	Pteronarcyidae	6
WVMTM-25-A	Perlidae	4
WVMTM-25-A	Peltoperlidae	2

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMTM-25-A	Chloroperlidae	3
WVMTM-25-A	Philopotamidae	26
WVMTM-25-A	Rhyacophilidae	5
WVMTM-25-A	Hydropsychidae	133
WVMTM-25-A	Glossosomatidae	1
WVMTM-25-A	Leptophlebiidae	3
WVMTM-25-A	Heptageniidae	10
WVMTM-25-A	Cambaridae	1
WVMTM-25-A	Chironomidae	3
WVMTM-25-A	Baetidae	5
WVMTM-26-B	Perlodidae	1
WVMTM-26-B	Empididae	1
WVMTM-26-B	Ceratopogonidae	3
WVMTM-26-B	Chironomidae	61
WVMTM-26-B	Tipulidae	4
WVMTM-26-B	Rhyacophilidae	13
WVMTM-26-B	Hydropsychidae	47
WVMTM-26-B	Baetidae	2
WVMTM-26-B	Heptageniidae	1
WVMTM-26-B	Philopotamidae	17
WVMTM-27	Sialidae	1
WVMTM-27	Hydropsychidae	19
WVMTM-27	Capniidae/Leuctrid	9
WVMTM-27	Chloroperlidae	2
WVMTM-27	Rhyacophilidae	6
WVMTM-27	Elmidae	1
WVMTM-27	Polycentropodidae	1
WVMTM-27	Tipulidae	2
WVMTM-27	Chironomidae	24
WVMTM-27	Dixidae	1
WVMTM-27	Cambaridae	1
WVMTM-27	Baetidae	4
WVMTM-27	Leptophlebiidae	3
WVMTM-27	Heptageniidae	4
WVMTM-27	Perlodidae	5
WVMT-35.5	Chironomidae	75
WVMT-35.5	Tabanidae	3
WVMT-35.5	Simuliidae	1
WVMT-35.5	Hydrophilidae	1
WVMT-35.5	Dytiscidae	1
WVMT-35.5	Coenagrionidae	2
WVMT-35.5	Calopterygidae	3
WVMT-35.5	Aeshnidae	1
WVMT-35.5	Physidae	11
WVMT-35.5	Oligochaeta	4
WVMT-35.5	Sphaeriidae	3
WVMT-36	Pyralidae	2
WVMT-36	Athericidae	1
WVMT-36	Tipulidae	1
WVMT-36	Corydalidae	2
WVMT-36	Veliidae	1
WVMT-36	Polycentropodidae	1
WVMT-36	Tabanidae	2
WVMT-36	Chironomidae	9
WVMT-36	Hydropsychidae	18
WVMT-36	Oligochaeta	1
WVMT-37-{0.0}	Empididae	1
WVMT-37-{0.0}	Corydalidae	13
WVMT-37-{0.0}	Simuliidae	1
WVMT-37-{0.0}	Tipulidae	8
WVMT-37-{0.0}	Corixidae	1
WVMT-37-{0.0}	Chironomidae	37
WVMT-37-{2.8}	Sialidae	2
WVMT-37-{2.8}	Chironomidae	8
WVMT-37-{2.8}	Tabanidae	2
WVMT-37-{2.8}	Tipulidae	26
WVMT-37-{2.8}	Corydalidae	3
WVMT-37-{2.8}	Capniidae/Leuctrid	26
WVMT-37-{2.8}	Polycentropodidae	6
WVMT-37-{2.8}	Ephemerellidae	12
WVMT-37-{2.8}	Asellidae	1
WVMT-37-{2.8}	Hydropsychidae	19
WVMT-38-A	Ceratopogonidae	1
WVMT-38-A	Polycentropodidae	1
WVMT-38-A	Chironomidae	12
WVMT-38-A	Psephenidae	2
WVMT-38-A	Philopotamidae	1
WVMT-38-A	Hydropsychidae	22
WVMT-38-A	Heptageniidae	11
WVMT-38-A	Leptophlebiidae	1
WVMT-38-A	Pyralidae	1
WVMT-40-{0.4}	Veliidae	2
WVMT-40-{0.4}	Chironomidae	19
WVMT-40-{0.4}	Tipulidae	3
WVMT-40-{0.4}	Carabidae	1
WVMT-40-{0.4}	Elmidae	1
WVMT-40-{0.4}	Perlidae	2
WVMT-40-{0.4}	Capniidae/Leuctrid	4
WVMT-40-{0.4}	Philopotamidae	8
WVMT-40-{0.4}	Rhyacophilidae	1
WVMT-40-{0.4}	Baetidae	36
WVMT-40-{0.4}	Cambaridae	2
WVMT-40-{0.4}	Simuliidae	11
WVMT-40-{0.6}	Corydalidae	1
WVMT-40-{0.6}	Heptageniidae	3
WVMT-40-{0.6}	Chironomidae	19
WVMT-40-{0.6}	Simuliidae	7
WVMT-40-{0.6}	Tipulidae	4
WVMT-40-{0.6}	Sialidae	2
WVMT-40-{0.6}	Polycentropodidae	1
WVMT-40-{0.6}	Cambaridae	2
WVMT-40-{0.6}	Hydropsychidae	11
WVMT-40-{0.6}	Baetidae	26

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-40-{0.6}	Capniidae/Leuctrid	6
WVMT-40-{0.6}	Philopotamidae	13
WVMT-40-A	Rhyacophilidae	3
WVMT-40-A	Chironomidae	23
WVMT-40-A	Tipulidae	17
WVMT-40-A	Corydalidae	1
WVMT-40-A	Elmidae	10
WVMT-40-A	Perlodidae	1
WVMT-40-A	Capniidae/Leuctrid	4
WVMT-40-A	Hydropsychidae	22
WVMT-40-A	Heptageniidae	2
WVMT-40-A	Baetidae	3
WVMT-40-A	Cambaridae	3
WVMT-40-A	Oligochaeta	3
WVMT-40-A	Perlidae	5
WVMT-42-{7.7} (Dup 1)	Limnephilidae	1
WVMT-42-{7.7}	Chironomidae	26
WVMT-42-{7.7}	Tipulidae	4
WVMT-42-{7.7}	Sialidae	22
WVMT-42-{7.7}	Lepidostomatidae	4
WVMT-42-{7.7}	Cambaridae	1
WVMT-42-{7.7}	Carabidae	2
WVMT-42-{7.7}	Polycentropodidae	22
WVMT-42-{7.7} (Dup 2)	Dryopidae	1
WVMT-42-{7.7}	Chironomidae	11
WVMT-42-{7.7}	Tabanidae	1
WVMT-42-{7.7}	Dytiscidae	2
WVMT-42-{7.7}	Aeshnidae	1
WVMT-42-{7.7}	Polycentropodidae	5
WVMT-42-{7.7}	Hydropsychidae	1
WVMT-42-{7.7}	Sialidae	7
WVMT-42-B-1-{1.3}	Sialidae	5
WVMT-42-B-1-{1.3}	Polycentropodidae	10
WVMT-42-B-1-{1.3}	Phryganeidae	1
WVMT-42-B-1-{1.3}	Capniidae/Leuctrid	6
WVMT-42-B-1-{1.3}	Corydalidae	17
WVMT-42-B-1-{1.3}	Chironomidae	57
WVMT-43-{13.2}	Simuliidae	1
WVMT-43-{13.2}	Empididae	1
WVMT-43-{13.2}	Cambaridae	1
WVMT-43-{13.2}	Chironomidae	30
WVMT-43-{13.2}	Corydalidae	8
WVMT-43-{13.2}	Psephenidae	11
WVMT-43-{13.2}	Elmidae	66
WVMT-43-{13.2}	Hydropsychidae	94
WVMT-43-{13.2}	Isonychiidae	13
WVMT-43-{13.2}	Heptageniidae	20
WVMT-43-{13.2}	Caenidae	1
WVMT-43-{13.2}	Baetidae	18
WVMT-43-{13.2}	Tipulidae	5
WVMT-43-{15.6}	Heptageniidae	30
WVMT-43-{15.6}	Elmidae	74
WVMT-43-{15.6}	Chironomidae	11
WVMT-43-{15.6}	Simuliidae	1
WVMT-43-{15.6}	Tipulidae	12
WVMT-43-{15.6}	Sialidae	4
WVMT-43-{15.6}	Corydalidae	1
WVMT-43-{15.6}	Haliplidae	22
WVMT-43-{15.6}	Helicopsychidae	8
WVMT-43-{15.6}	Philopotamidae	1
WVMT-43-{15.6}	Hydropsychidae	36
WVMT-43-{15.6}	Leptophlebiidae	1
WVMT-43-{15.6}	Baetidae	59
WVMT-43-{15.6}	Cambaridae	2
WVMT-43-{15.6}	Oligochaeta	2
WVMT-43-{15.6}	Nematoda	1
WVMT-43-{15.6}	Isonychiidae	16
WVMT-43-A	Hydropsychidae	9
WVMT-43-A	Chironomidae	36
WVMT-43-A	Tabanidae	2
WVMT-43-A	Tipulidae	2
WVMT-43-A	Heptageniidae	1
WVMT-43-A	Baetidae	5
WVMT-43-A	Cambaridae	4
WVMT-43-A	Oligochaeta	21
WVMT-43-A	Elmidae	19
WVMT-43-A	Gomphidae	1
WVMT-43-F-1	Polycentropodidae	1
WVMT-43-F-1	Chironomidae	18
WVMT-43-F-1	Tipulidae	2
WVMT-43-F-1	Psephenidae	3
WVMT-43-F-1	Elmidae	1
WVMT-43-F-1	Perlidae	5
WVMT-43-F-1	Capniidae/Leuctrid	19
WVMT-43-F-1	Philopotamidae	14
WVMT-43-F-1	Oligochaeta	1
WVMT-43-F-1	Hydropsychidae	102
WVMT-43-F-1	Glossosomatidae	1
WVMT-43-F-1	Leptophlebiidae	32
WVMT-43-F-1	Heptageniidae	39
WVMT-43-F-1	Ephemeridae	1
WVMT-43-F-1	Baetidae	22
WVMT-43-F-1	Cambaridae	3
WVMT-43-F-1	Rhyacophilidae	2
WVMT-43-F-1	Chloroperlidae	1
WVMT-43-H	Chironomidae	47
WVMT-43-H	Tabanidae	9
WVMT-43-H	Ceratopogonidae	9
WVMT-43-H	Elmidae	1
WVMT-43-H	Calopterygidae	1
WVMT-43-H	Hydropsychidae	4
WVMT-43-H	Oligochaeta	15

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-43-H	Baetidae	7
WVMT-43-M	Elmidae	35
WVMT-43-M	Capniidae/Leuctrid	1
WVMT-43-M	Chironomidae	58
WVMT-43-M	Simuliidae	2
WVMT-43-M	Ceratopogonidae	3
WVMT-43-M	Tipulidae	5
WVMT-43-M	Corydalidae	3
WVMT-43-M	Psephenidae	12
WVMT-43-M	Peltoperlidae	1
WVMT-43-M	Chloroperlidae	1
WVMT-43-M	Oligochaeta	1
WVMT-43-M	Philopotamidae	4
WVMT-43-M	Hydropsychidae	218
WVMT-43-M	Isonychiidae	50
WVMT-43-M	Leptophlebiidae	25
WVMT-43-M	Heptageniidae	48
WVMT-43-M	Ephemeridae	1
WVMT-43-M	Baetidae	53
WVMT-43-M	Perlodidae	1
WVMT-43-O	Chironomidae	42
WVMT-43-O	Corydalidae	2
WVMT-43-O	Baetidae	35
WVMT-43-O	Simuliidae	3
WVMT-43-O	Tipulidae	8
WVMT-43-O	Psephenidae	1
WVMT-43-O	Elmidae	5
WVMT-43-O	Dryopidae	1
WVMT-43-O	Ephemerellidae	1
WVMT-43-O	Odontoceridae	3
WVMT-43-O	Limnephilidae	1
WVMT-43-O	Hydropsychidae	1
WVMT-43-O	Leptophlebiidae	1
WVMT-43-O	Gomphidae	1
WVMT-43-O	Tabanidae	1
WVMT-45	Gomphidae	1
WVMT-45	Elmidae	14
WVMT-45	Psephenidae	13
WVMT-45	Corydalidae	4
WVMT-45	Athericidae	2
WVMT-45	Chironomidae	11
WVMT-45	Perlidae	1
WVMT-45	Glossosomatidae	1
WVMT-45	Simuliidae	5
WVMT-45	Pleuroceridae	1
WVMT-45	Philopotamidae	1
WVMT-45	Ancylidae	1
WVMT-45	Polycentropodidae	1
WVMT-45	Baetidae	1
WVMT-45	Heptageniidae	34
WVMT-45	Isonychiidae	7
WVMT-45	Hydropsychidae	51
WVMT-45	Psycomyiidae	1
WVMT-45	Oligochaeta	1
WVMT-48	Leptophlebiidae	3
WVMT-48	Psephenidae	8
WVMT-48	Chironomidae	32
WVMT-48	Simuliidae	2
WVMT-48	Empididae	1
WVMT-48	Tipulidae	7
WVMT-48	Athericidae	1
WVMT-48	Corydalidae	6
WVMT-48	Gomphidae	1
WVMT-48	Oligochaeta	3
WVMT-48	Hydropsychidae	50
WVMT-48	Cambaridae	1
WVMT-48	Heptageniidae	6
WVMT-48	Baetidae	1
WVMT-48	Odontoceridae	3
WVMT-48	Elmidae	25
WVMT-50	Chironomidae	34
WVMT-50	Philopotamidae	22
WVMT-50	Perlidae	1
WVMT-50	Elmidae	28
WVMT-50	Psephenidae	6
WVMT-50	Tipulidae	4
WVMT-50	Simuliidae	14
WVMT-50	Hydropsychidae	58
WVMT-50	Ceratopogonidae	1
WVMT-50	Pleuroceridae	2
WVMT-50	Capniidae/Leuctrid	1
WVMT-50	Oligochaeta	1
WVMT-50	Isonychiidae	10
WVMT-50	Viviparidae	1
WVMT-50	Baetidae	12
WVMT-50	Caenidae	1
WVMT-50	Ephemerellidae	1
WVMT-50	Leptophlebiidae	5
WVMT-50	Heptageniidae	37
WVMT-50-A-1	Chloroperlidae	10
WVMT-50-A-1	Chironomidae	29
WVMT-50-A-1	Tipulidae	5
WVMT-50-A-1	Elmidae	3
WVMT-50-A-1	Perlodidae	3
WVMT-50-A-1	Pteronarcyidae	2
WVMT-50-A-1	Baetidae	14
WVMT-50-A-1	Limnephilidae	1
WVMT-50-A-1	Philopotamidae	24
WVMT-50-A-1	Rhyacophilidae	1
WVMT-50-A-1	Hydropsychidae	70
WVMT-50-A-1	Glossosomatidae	3
WVMT-50-A-1	Heptageniidae	8
WVMT-50-A-1	Leptophlebiidae	15
WVMT-50-A-1	Capniidae/Leuctrid	14
WVMT-50-B-3	Capniidae/Leuctrid	2

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-50-B-3	Chironomidae	2
WVMT-50-B-3	Simuliidae	1
WVMT-50-B-3	Tipulidae	1
WVMT-50-B-3	Pteronarcyidae	1
WVMT-50-B-3	Perlidae	4
WVMT-50-B-3	Chloroperlidae	1
WVMT-50-B-3	Philopotamidae	9
WVMT-50-B-3	Hydropsychidae	27
WVMT-50-B-3	Glossosomatidae	4
WVMT-50-B-3	Heptageniidae	3
WVMT-50-B-3	Baetidae	6
WVMT-50-B-3	Cambaridae	3
WVMT-50-B-3	Oligochaeta	1
WVMT-50-B-3	Peltoperlidae	1
WVMT-57-{0.4}	Dryopidae	1
WVMT-57-{0.4}	Chironomidae	30
WVMT-57-{0.4}	Tabanidae	1
WVMT-57-{0.4}	Tipulidae	8
WVMT-57-{0.4}	Veliidae	3
WVMT-57-{0.4}	Corydalidae	2
WVMT-57-{0.4}	Elmidae	14
WVMT-57-{0.4}	Baetidae	8
WVMT-57-{0.4}	Chloroperlidae	2
WVMT-57-{0.4}	Philopotamidae	29
WVMT-57-{0.4}	Hydropsychidae	33
WVMT-57-{0.4}	Isonychiidae	2
WVMT-57-{0.4}	Leptophlebiidae	18
WVMT-57-{0.4}	Heptageniidae	5
WVMT-57-{0.4}	Psephenidae	2
WVMT-57-{0.4}	Perlidae	6
WVMT-61-{2.0}	Chloroperlidae	2
WVMT-61-{2.0}	Tipulidae	1
WVMT-61-{2.0}	Ceratopogonidae	3
WVMT-61-{2.0}	Empididae	1
WVMT-61-{2.0}	Chironomidae	26
WVMT-61-{2.0}	Philopotamidae	43
WVMT-61-{2.0}	Simuliidae	1
WVMT-61-{2.0}	Glossosomatidae	3
WVMT-61-{2.0}	Isonychiidae	22
WVMT-61-{2.0}	Leptophlebiidae	15
WVMT-61-{2.0}	Heptageniidae	8
WVMT-61-{2.0}	Baetidae	7
WVMT-61-{2.0}	Cambaridae	1
WVMT-61-{2.0}	Hydropsychidae	79
WVMT-61-{2.0}	Corydalidae	2
WVMT-64-{6.7}	Chironomidae	82
WVMT-64-{6.7}	Pteronarcyidae	1
WVMT-64-{6.7}	Perlodidae	3
WVMT-64-{6.7}	Tipulidae	2
WVMT-64-{6.7}	Heptageniidae	20
WVMT-64-{6.7}	Empididae	3
WVMT-64-{6.7}	Simuliidae	5
WVMT-64-{6.7}	Perlidae	9
WVMT-64-{6.7}	Chloroperlidae	13
WVMT-64-{6.7}	Capniidae/Leuctrid	3
WVMT-64-{6.7}	Philopotamidae	82
WVMT-64-{6.7}	Hydropsychidae	109
WVMT-64-{6.7}	Baetidae	59
WVMT-64-{6.7}	Cambaridae	2
WVMT-64-{6.7}	Rhyacophilidae	35
WVMT-64-{6.7}	Peltoperlidae	6
WVMT-64-A.5	Perlodidae	1
WVMT-64-A.5	Chironomidae	21
WVMT-64-A.5	Simuliidae	4
WVMT-64-A.5	Ceratopogonidae	7
WVMT-64-A.5	Psephenidae	4
WVMT-64-A.5	Heptageniidae	25
WVMT-64-A.5	Tipulidae	1
WVMT-64-A.5	Baetidae	10
WVMT-64-A.5	Philopotamidae	4
WVMT-64-A.5	Leptophlebiidae	4
WVMT-64-A.5	Isonychiidae	2
WVMT-64-A.5	Glossosomatidae	2
WVMT-64-A.5	Hydropsychidae	9
WVMT-64-C	Chloroperlidae	3
WVMT-64-C	Rhyacophilidae	6
WVMT-64-C	Tabanidae	1
WVMT-64-C	Tipulidae	4
WVMT-64-C	Elmidae	4
WVMT-64-C	Perlodidae	7
WVMT-64-C	Pteronarcyidae	9
WVMT-64-C	Peltoperlidae	4
WVMT-64-C	Chironomidae	13
WVMT-64-C	Baetidae	19
WVMT-64-C	Capniidae/Leuctrid	6
WVMT-64-C	Asellidae	1
WVMT-64-C	Ephemerellidae	2
WVMT-64-C	Heptageniidae	11
WVMT-64-C	Glossosomatidae	1
WVMT-64-C	Hydropsychidae	52
WVMT-64-C	Oligochaeta	2
WVMT-64-C	Philopotamidae	5
WVMT-64-C	Cambaridae	1
WVMT-64-E	Hydropsychidae	7
WVMT-64-E	Chironomidae	21
WVMT-64-E	Simuliidae	1
WVMT-64-E	Tipulidae	4
WVMT-64-E	Perlodidae	6
WVMT-64-E	Peltoperlidae	4
WVMT-64-E	Chloroperlidae	11
WVMT-64-E	Rhyacophilidae	9
WVMT-64-E	Ameletidae	2
WVMT-64-E	Heptageniidae	2
WVMT-64-E	Baetidae	10
WVMT-64-E	Cambaridae	3

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-64-E	Capniidae/Leuctrid	26
WVMT-64-F	Chloroperlidae	51
WVMT-64-F	Chironomidae	16
WVMT-64-F	Dryopidae	1
WVMT-64-F	Perlodidae	1
WVMT-64-F	Peltoperlidae	1
WVMT-64-F	Polycentropodidae	2
WVMT-64-F	Rhyacophilidae	19
WVMT-64-F	Ameletidae	4
WVMT-64-F	Ephemerellidae	6
WVMT-64-F	Baetidae	3
WVMT-64-F	Cambaridae	1
WVMT-64-F	Tipulidae	1
WVMT-64-F	Capniidae/Leuctrid	56
WVMT-66	Corydalidae	1
WVMT-66	Chironomidae	59
WVMT-66	Ceratopogonidae	12
WVMT-66	Psephenidae	1
WVMT-66	Hydrophilidae	1
WVMT-66	Elmidae	1
WVMT-66	Gomphidae	1
WVMT-66	Polycentropodidae	1
WVMT-66	Philopotamidae	1
WVMT-66	Hydropsychidae	50
WVMT-66	Lymnaeidae	1
WVMT-66	Brachycentridae	1
WVMT-66	Baetidae	2
WVMT-66	Heptageniidae	2
WVMT-66	Empididae	7
WVMT-66	Perlidae	1
WVMT-66-B	Philopotamidae	5
WVMT-66-B	Chironomidae	102
WVMT-66-B	Ceratopogonidae	3
WVMT-66-B	Hydropsychidae	5
WVMT-66-B	Glossosomatidae	1
WVMT-66-B	Baetidae	13
WVMT-66-B	Simuliidae	2
WVMT-68	Chironomidae	126
WVMT-68	Simuliidae	3
WVMT-68	Elmidae	2
WVMT-68	Empididae	1
WVMT-68	Leptophlebiidae	1
WVMT-68	Tipulidae	8
WVMT-68	Athericidae	2
WVMT-68	Corydalidae	1
WVMT-68	Psephenidae	1
WVMT-68	Baetidae	27
WVMT-68	Capniidae/Leuctrid	1
WVMT-68	Polycentropodidae	1
WVMT-68	Philopotamidae	167
WVMT-68	Hydropsychidae	133
WVMT-68	Glossosomatidae	6
WVMT-68	Isonychiidae	16
WVMT-68	Heptageniidae	29
WVMT-68	Brachycentridae	1
WVMT-68	Chloroperlidae	1
WVMT-68-D	Pteronarcyidae	10
WVMT-68-D	Perlodidae	1
WVMT-68-D	Corydalidae	2
WVMT-68-D	Tipulidae	7
WVMT-68-D	Perlidae	8
WVMT-68-D	Chironomidae	20
WVMT-68-D	Leptophlebiidae	5
WVMT-68-D	Ceratopogonidae	4
WVMT-68-D	Peltoperlidae	1
WVMT-68-D	Chloroperlidae	1
WVMT-68-D	Capniidae/Leuctrid	1
WVMT-68-D	Hydropsychidae	59
WVMT-68-D	Heptageniidae	6
WVMT-68-D	Gammaridae	3
WVMT-68-D	Cambaridae	1
WVMT-68-D	Philopotamidae	5
WVMT-69	Corydalidae	1
WVMT-69	Cambaridae	1
WVMT-69	Baetidae	3
WVMT-69	Ephemerellidae	1
WVMT-69	Heptageniidae	3
WVMT-69	Leptophlebiidae	1
WVMT-69	Hydropsychidae	15
WVMT-69	Polycentropodidae	2
WVMT-69	Veliidae	3
WVMT-69	Tipulidae	2
WVMT-69	Chironomidae	90
WVMT-69	Philopotamidae	13
WVMT-74	Philopotamidae	2
WVMT-74	Corydalidae	11
WVMT-74	Pleuroceridae	2
WVMT-74	Glossosomatidae	3
WVMT-74	Chironomidae	33
WVMT-74	Tipulidae	10
WVMT-74	Veliidae	1
WVMT-74	Psephenidae	8
WVMT-74	Elmidae	36
WVMT-74	Gomphidae	1
WVMT-74	Ephemeridae	6
WVMT-74	Athericidae	9
WVMT-74	Baetidae	15
WVMT-74	Perlidae	23
WVMT-74	Heptageniidae	20
WVMT-74	Leptophlebiidae	13
WVMT-74	Isonychiidae	155
WVMT-74	Hydropsychidae	100
WVMT-74	Odontoceridae	1

Table A-6. Numbers of each taxon found at each sample site (cont.)

Sample site	Taxa	No. of individuals
WVMT-74	Cambaridae	3
WVMT-74-B-1	Peltoperlidae	2
WVMT-74-B-1	Corydalidae	7
WVMT-74-B-1	Dixidae	2
WVMT-74-B-1	Chironomidae	6
WVMT-74-B-1	Athericidae	4
WVMT-74-B-1	Elmidae	31
WVMT-74-B-1	Gomphidae	1
WVMT-74-B-1	Perlodidae	9
WVMT-74-B-1	Perlidae	4
WVMT-74-B-1	Tipulidae	1
WVMT-74-B-1	Cambaridae	3
WVMT-74-B-1	Chloroperlidae	2
WVMT-74-B-1	Gammaridae	4
WVMT-74-B-1	Heptageniidae	5
WVMT-74-B-1	Leptophlebiidae	28
WVMT-74-B-1	Hydropsychidae	46
WVMT-74-B-1	Rhyacophilidae	4
WVMT-74-B-1	Philopotamidae	3
WVMT-74-B-1	Polycentropodidae	2
WVMT-74-B-1	Baetidae	2
WVMT-75-{16.2}	Chironomidae	34
WVMT-75-{16.2}	Curculionidae	1
WVMT-75-{16.2}	Tipulidae	12
WVMT-75-{16.2}	Pyralidae	1
WVMT-75-{16.2}	Corydalidae	30
WVMT-75-{16.2}	Staphylinidae	1
WVMT-75-{16.2}	Dixidae	3
WVMT-75-{16.2}	Elmidae	49
WVMT-75-{16.2}	Ephemerellidae	7
WVMT-75-{16.2}	Perlodidae	16
WVMT-75-{16.2}	Pteronarcyidae	2
WVMT-75-{16.2}	Perlidae	18
WVMT-75-{16.2}	Psephenidae	1
WVMT-75-{16.2}	Isonychiidae	3
WVMT-75-{16.2}	Peltoperlidae	5
WVMT-75-{16.2}	Limnephilidae	4
WVMT-75-{16.2}	Philopotamidae	34
WVMT-75-{16.2}	Rhyacophilidae	6
WVMT-75-{16.2}	Gammaridae	1
WVMT-75-{16.2}	Polycentropodidae	2
WVMT-75-{16.2}	Chloroperlidae	47
WVMT-75-{16.2}	Leptophlebiidae	60
WVMT-75-{16.2}	Heptageniidae	69
WVMT-75-{16.2}	Ephemeridae	9
WVMT-75-{16.2}	Baetidae	93
WVMT-75-{16.2}	Cambaridae	1
WVMT-75-{16.2}	Capniidae/Leuctrid	6
WVMT-75-{16.2}	Hydropsychidae	124
WVMT-78	Baetidae	3
WVMT-78	Chironomidae	54
WVMT-78	Tipulidae	1
WVMT-78	Veliidae	1
WVMT-78	Psephenidae	44
WVMT-78	Elmidae	16
WVMT-78	Perlidae	2
WVMT-78	Philopotamidae	8
WVMT-78	Hydropsychidae	75
WVMT-78	Isonychiidae	67
WVMT-78	Leptophlebiidae	2
WVMT-78	Ephemeridae	2
WVMT-78	Pleuroceridae	4
WVMT-78	Oligochaeta	1
WVMT-78	Heptageniidae	21
WVMT-79-{0.9}	Leptophlebiidae	18
WVMT-79-{0.9}	Ephemerellidae	19
WVMT-79-{0.9}	Hydropsychidae	26
WVMT-79-{0.9}	Dixidae	1
WVMT-79-{0.9}	Baetidae	5
WVMT-79-{0.9}	Ephemeridae	4
WVMT-79-{0.9}	Heptageniidae	43
WVMT-79-{0.9}	Isonychiidae	22
WVMT-79-{0.9}	Rhyacophilidae	10
WVMT-79-{0.9}	Corydalidae	2
WVMT-79-{0.9}	Capniidae/Leuctrid	4
WVMT-79-{0.9}	Chloroperlidae	4
WVMT-79-{0.9}	Perlidae	5
WVMT-79-{0.9}	Elmidae	8
WVMT-79-{0.9}	Philopotamidae	4
WVMT-79-{0.9}	Hirudinidae	4
WVMT-79-{0.9}	Chironomidae	14
WVMT-81-{0.8}	Capniidae/Leuctrid	2
WVMT-81-{0.8}	Perlidae	14
WVMT-81-{0.8}	Elmidae	37
WVMT-81-{0.8}	Psephenidae	8
WVMT-81-{0.8}	Corydalidae	24
WVMT-81-{0.8}	Simuliidae	1
WVMT-81-{0.8}	Chironomidae	121
WVMT-81-{0.8}	Philopotamidae	31
WVMT-81-{0.8}	Caenidae	1
WVMT-81-{0.8}	Tipulidae	10
WVMT-81-{0.8}	Rhyacophilidae	3
WVMT-81-{0.8}	Hydropsychidae	716
WVMT-81-{0.8}	Glossosomatidae	2
WVMT-81-{0.8}	Isonychiidae	263
WVMT-81-{0.8}	Leptophlebiidae	54
WVMT-81-{0.8}	Heptageniidae	21
WVMT-81-{0.8}	Ephemerellidae	18
WVMT-81-{0.8}	Baetidae	74
WVMT-81-{0.8}	Cambaridae	2
WVMT-81-{0.8}	Ephemeridae	8

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria

Stream Code	Temp (°C)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVM-27-{115.0}	28.9	7.3	6.7	116	245
WVM-27-{46.2}	20.8	7.4	6.5	185	360
WVM-27-{83.0}	22.7	7	8.5	146	1269
WVM-27-{93.6}	21.1	6.9	7.5	140	275
WVMT-4	22.7	6.9	7.5	918	10
WVMT-5	18.1	7.8	8.9	252	100
WVMT-7	16.6	7.1	9	103	91
WVMT-8	18.7	7.2	9.4	128	60
WVMT-11-{6.6}	17.8	7.3	8.9	203	6000
WVMT-11-A	24.2	7.3	6.9	666	6000
WVMT-11-B	21.5	7.4	8.6	974	950
WVMT-11-B-1	20.3	6.9	7.6	577	520
WVMT-12-{10.2}	25	4.3	7.3	538	0
WVMT-18-{9.6}	20.6	7.2	7.5	66	1250
WVMT-18-E-{0.4}	15.74	3.53	7.86	554	2
WVMT-18-E-3-A-{1.2}	15.6	7.7	8.1	221	1683
WVMT-18-E-4-A	18.8	7.5	8.5	80	1045
WVMT-18-G-2	18	6.9	8.2	39	630
WVMT-22	15.5	7.2	6.3	115	117
WVMT-23	19.5	7.2	8.3	103	217
WVMT-23-B-1	16.2	7.4	8.4	93	700
WVMT-23-C-{5.6}	14.4	7.6	8.6	96	240
WVMT-23-F	18.1	6.4	7.4	41	92
WVMT-24-{0.03}	19	7.6	8.5	227	258
WVMT-24-A	20.6	7	7.2	402	268
WVMT-24-C	22.3	7	8.5	142	35
WVMT-24-C-1.5-A	17.5	6.4	4.3	158	8
WVMT-24-C-2	17.6	6.9	4.9	138	185
WVMT-24-C-3.5	17	7.2	6.8	70	1288
WVMT-26-{0.4}	21.2	8.1	8.6	2610	500
WVMT-26-B	19.4	8.1	8.5	4000	632
WVMT-26-C	23.12	8.09	7.55	2040	1200
WVMT-29	17.6	7.4	7.2	417	6000
WVMT-31-{6.6}	20.5	7.4	7.5	229	16
WVMTB-1	15.3	7.2	7.3	221	104
WVMTB-5	19.5	8	10	742	16
WVMTB-5-B	17.8	7.5	6.2	1268	520
WVMTB-5-C	22.1	7.1	6.2	334	488
WVMTB-7-{1.0}	20.3	7.5	8	288	767
WVMTB-7-A-{0.5}	17.3	7.6	8.5	142	7280
WVMTB-7-A-{2.9}	16.6	7.5	7.5	143	636
WVMTB-7-C-{0.32}	12.3	7.6	8.9	65	730
WVMTB-8	18.6	7.9	7.8	634	2520
WVMTB-9	18	7.4	6.8	296	1684
WVMTB-10-A	26.3	7.5	11.1	751	795
WVMTB-11	22.3	7.3	7.2	409	270
WVMTB-11-B	23.5	6.7	6.7	395	17
WVMTB-11-B.5	20.6	6.9	6.6	556	3100
WVMTB-11-B.7	19.5	3.3	4.6	866	18
WVMTB-18-{11.2}	19.4	7.4	5.4	122	340
WVMTB-18-B	20.9	7.8	7.5	1312	596

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria (continued)

Stream Code	Temp (°C)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVMTB-18-B-2	20.6	7.2	7.4	1453	468
WVMTB-18-B-3	22.3	7.1	7.1	116	1400
WVMTB-18-D-{3.9}	16.2	6.2	5.3	78	160
WVMTB-19-{0.9}	13.4	7.5	7.9	165	180
WVMTB-20	16.2	7.4	9	578	70
WVMTB-24	12.8	7.6	8.6	121	620
WVMTB-25	17	5.8	8.6	1590	2
WVMTB-25-A	17.3	7.1	7.4	119	16
WVMTB-27	13.7	5.9	9.1	87	2
WVMTB-28	16.2	7.6	7.9	106	191
WVMTB-29	18	3.6	7.9	491	1
WVMTB-30	15.1	6.5	6.8	86	400
WVMTB-31	17	7.4	8.2	114	20
WVMTB-31-C	14.2	7.3	7.7	82	40
WVMTB-31-D	13.9	7.5	7.6	41	41
WVMTB-31-F-1	16.8	7.9	7.8	41	5
WVMTB-31-F-2-{0.8}	16.7	7.5	6.9	69	5
WVMTB-31-F-5	15.4	7.5	6.8	34	7
WVMTB-31-J	13	6.9	9.4	41	20
WVMTB-32-{0.4}	18.4	7.6	8.2	71	1
WVMTB-32-{0.4}	16.9	6.9	9.2	72	14
WVMTB-32-D	14.7	6.4	8.2	34	24
WVMTB-32-H	14.4	7.4	9.2	52	7
WVMTB-32-I-1	17.7	5.1	8.2	28	0
WVMT-33-{11.8}	19.1	7.5	8	89	123
WVMTM-0.5-{0.6}	16.5	7.6	7.6	101	751
WVMTM-1	16.1	7.4	8.5	48	117
WVMTM-2	14.9	7.3	8.3	54	225
WVMTM-3	20.9	6	7.1	293	0
WVMTM-5	16.2	4.8	7.7	33	63
WVMTM-7	15.8	5.8	7.7	35	12
WVMTM-11-{0.3}	18.3	7.3	8.2	86	249
WVMTM-11-{7.6}	15.5	7.9	7.9	136	0
WVMTM-11-E	17.8	7.2	8.5	74	304
WVMTM-13-{0.8}	17	8.4	8.3	240	20
WVMTM-17	17.7	8.6	8.1	178	200
WVMTM-21	17.1	7.1	7.1	100	80
WVMTM-25-{1.5}	16.2	7	7.9	40	140
WVMTM-25-A	16.1	7.7	8.3	92	20
WVMTM-26-B	13.3	7.8	8.7	59	1
WVMTM-27	13.1	7.3	7.3	45	0
WVMT-35.5	17.9	7.3	5.2	133	3200
WVMT-36	15.9	6.8	8.4	408	680
WVMT-37-{0.0}	15.4	3.5	9.2	619	0
WVMT-37-{2.8}	14.7	5.1	6.3	328	0
WVMT-38-A	15.4	6.7	3.6	53	320
WVMT-40-{0.4}	12.6	7	8.7	112	9
WVMT-40-{0.6}	13.3	7.1	9	129	9
WVMT-40-A	12.9	7.4	7	52	13
WVMT-41-{1.0}	11.8	3.1	8.6	984	2
WVMT-42-{7.7}	13.3	4.5	7.8	304	16

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria (continued)

Stream Code	Temp (°C)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVMT-42-{7.7}	13.3	4.5	7.8	304	6
WVMT-42-B-1-{1.3}	15.4	3.3	7.5	810	0
WVMT-43-{13.2}	24.8	6.9	7.8	78	232
WVMT-43-{15.6}	25.3	7.1	8.5	86	1535
WVMT-43-A	20.7	6.7	7.6	250	1757
WVMT-43-F-1	18.1	6.4	8.2	88	60
WVMT-43-H	16.7	6.8	5.7	98	3800
WVMT-43-M	22.6	7.6	7.8	127	258
WVMT-43-O	20	7.2	8.2	54	171
WVMT-45	16.9	6.6	8.8	222	920
WVMT-48	17.8	6.7	8.3	163	1076
WVMT-50	20.1	6.6	8.4	114	377
WVMT-50-A-1	16.4	6.5	8.9	100	48
WVMT-50-B-3	15.5	6.7	8.7	54	160
WVMT-57-{0.4}	16.1	7.2	8.4	117	472
WVMT-61-{2.0}	18.1	6.6	7.1	67	275
WVMT-64-{6.7}	14.2	6.8	8.4	26	0
WVMT-64-A.5	17.1	7	6.5	76	841
WVMT-64-C	13.9	6.7	7.2	24	33
WVMT-64-E	13.7	4.7	8.4	15	155
WVMT-64-F	14	4.6	8.5	15	39
WVMT-66	28.6	7.8	5.9	169	80
WVMT-66-B	19.7	7.2	8.3	102	2540
WVMT-68	18	7.6	8.9	107	1
WVMT-68-D	15	7.4	5.9	129	1009
WVMT-69	18.1	7.3	6.9	98	5655
WVMT-74	17.8	7.7	8	119	568
WVMT-74-B-1	14.3	8	8.6	138	33
WVMT-75-{16.2}	16.1	7.6	6.9	147	0
WVMT-78	16.4	8	8.2	134	1170
WVMT-79-{0.9}	14	7.4	7.9	132	37
WVMT-81-{0.8}	17.8	8.1	7.7	132	4

Table A-8a. Additional water quality parameters taken from a subset of all streams sampled

Stream Code	Hot acidity (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)	Total Al (mg/L)	Dis Al (mg/L)	Total Fe (mg/L)	Dis Fe (mg/L)	Total Mn (mg/L)
WVM-27-{115.0}	<1	50	6	0.100	0.033	0.270	0.125	0.089
WVM-27-{83.0}	<1	42	<5	0.220	0.049	0.810	0.203	0.076
WVM-27-{93.6}	<1	40	6	0.081	0.054	0.480	0.226	0.057
WVMT-4	<1	16	430	1.200		0.430		0.630
WVMT-5	<1	47	78	<0.050		0.110		<0.020
WVMT-7	<1	31	21	<0.050	0.041	0.087	0.036	<0.020
WVMT-8	<1	42	13	<0.050	0.033	0.220	0.087	<0.020
WVMT-11-{6.6}	<1	89	18	0.130	0.050	0.370	0.065	0.087
WVMT-11-A	<1	45	320	<0.050		0.180		0.091
WVMT-11-B	<1	35	240	0.360		1.100		0.420
WVMT-11-B-1	<1	80	580*	0.130		0.500		0.450
WVMT-12-{10.2}	51	<1	250	7.300	3.836	0.170	0.106	2.100
WVMT-18-{9.6}	<1	22	11	0.210	0.040	0.340	0.170	0.047
WVMT-18-E-{0.4}	89	<1.0	200	10.0	10.060	1.7	1.542	1.0
WVMT-18-E-3-A-{1.2}	<1	86	45	0.300	0.053	0.670	0.268	0.050
WVMT-22				0.095	0.030	0.122	0.047	0.008
WVMT-23-C-{5.6}	<1	36	6	0.250	0.038	0.180	0.032	<0.020
WVMT-24-A	<1	42	120	0.071		0.850		1.100
WVMT-24-C-2				0.104	0.047	0.876	0.405	0.197
WVMT-24-C-3.5				0.394	0.044	0.727	0.172	0.08
WVMT-26-{0.4}	<1	190	1000	<0.050	0.038	<0.050	0.045	0.060
WVMT-26-B	<1	160	2300	0.180		0.180		0.140
WVMT-26-C	<1.0	230	710	<0.05		0.18		0.078
WVMT-29	<1	100	110	0.090		0.500		0.290
WVMT-31-{6.6}	<1	37	62	<0.050	0.063	0.160	0.135	0.071
WVMTB-1	<1	79	13	0.100		0.310		0.022
WVMTB-5	<1	96	500	<0.050		0.067		0.023
WVMTB-5-B	<1	110	670	0.140		0.780		1.580
WVMTB-5-C	<1	160	40	0.092		0.480		0.310
WVMTB-7-A-{0.5}	<1	38	21	0.110	0.038	0.200	0.064	0.040
WVMTB-7-A-{2.9}	<1	36	29	0.120	0.087	0.200	0.082	0.089
WVMTB-7-C-{0.32}	<1	27	<5	0.140	0.089	0.870	0.485	0.190
WVMTB-10-A	<1	52	690	0.064		0.320		0.460
WVMTB-11	<1	65	230	0.120		1.000		0.250
WVMTB-11-B	<3	32	78	0.150		1.000		0.610
WVMTB-11-B.7	81	<1	720	2.600		17.000		2.300
WVMTB-18-{11.2}	<1	50	6	0.150	0.147	1.200	0.684	0.510
WVMTB-18-B	<1	290	560	0.170		2.400		0.270
WVMTB-18-B-2	<1	280	960	0.130		3.600		1.000
WVMTB-18-B-3	<1	50	5	0.170		1.200		0.130
WVMTB-18-D-{3.9}	<1	24	<5	0.055	0.061	0.240	0.140	<0.020
WVMTB-19-{0.9}	<1	77	<5	0.260	0.041	0.490	0.227	0.200
WVMTB-20	<1	80	350	0.057		0.370		0.150
WVMTB-25	6	4	1200	0.240		0.780		1.300
WVMTB-25-A				0.114	0.048	0.186	0.186	0.111
WVMTB-27	3	4	29	0.067		0.098		0.066
WVMTB-29	61	<1	220	7.500		0.300		5.300
WVMTB-31-F-1				0.054	0.044	0.093	0.071	0.007
WVMTB-31-F-2-{0.8}	<1	25	5	0.056	0.049	0.170	0.104	<0.020
WVMTB-31-F-5				0.057	0.030	0.069	0.049	0.005
WVMTB-32-{0.4}	<1	15	15	<0.050		0.140		<0.020
WVMTB-32-I-1	4	3	<5	0.098	0.132	0.055	0.023	0.055

Table A-8a. Additional water quality parameters taken from a subset of all streams sampled (continued)

Stream Code	Hot acidity (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)	Total Al (mg/L)	Dis Al (mg/L)	Total Fe (mg/L)	Dis Fe (mg/L)	Total Mn (mg/L)
WVMT-33-{11.8}	<1	20	17	0.080	0.079	0.230	0.135	0.064
WVMTM-0.5-{0.6}	<1	32	6	0.280	0.082	0.740	0.226	0.062
WVMTM-1				0.086	0.033	0.328	0.061	0.018
WVMTM-3	2	8	91	0.230		3.800		4.100
WVMTM-7	4			0.130		0.430		0.130
WVMTM-11-{0.3}	<1	34	<5	<0.050	0.058	0.310	0.152	0.042
WVMTM-11-{7.6}	<1	66	<5	0.070	0.019	0.120	0.050	<0.020
WVMTM-13-{0.8}				0.053	0.032	0.192	0.091	0.011
WVMTM-25-{1.5}	<1	10	<5	0.085	0.007	0.170	0.166	<0.020
WVMT-36	<1	57	220	0.250		1.000		0.850
WVMT-37-{0.0}	65	<1	520	8.200		1.300		1.500
WVMT-37-{2.8}	7	3	200	0.440	0.318	1.000	0.371	0.890
WVMT-40-{0.4}	<1	15	46	0.051		0.170		0.045
WVMT-40-{0.6}				0.065	0.037	0.124	0.067	0.041
WVMT-41-{1.0}	180	<1	590	<0.050	14.246	0.110	15.680	<0.020
WVMT-42-{7.7}	12	3	210	1.800	1.866	0.480	0.390	2.500
WVMT-42-{7.7}	12	3	210	1.800	1.866	0.480	0.390	2.500
WVMT-42-B-1-{1.3}	170	<1	350	0.420	19.604	0.240	1.939	0.310
WVMT-43-{13.2}	<1	31	7	0.200	0.040	0.900	0.218	0.063
WVMT-43-{15.6}	<1	19	8	0.097	0.048	0.590	0.217	0.021
WVMT-43-M				0.142	0.062	0.226	0.084	0.009
WVMT-43-O				0.208	0.065	0.389	0.142	0.017
WVMT-45				0.077	0.044	0.197		0.039
WVMT-48	<1	40	11	0.068	0.043	0.660	0.153	0.034
WVMT-50				0.060	0.049	0.157		0.017
WVMT-57-{0.4}	<1	31	7	<0.050	0.050	0.150	0.082	<0.020
WVMT-61-{2.0}	<1	28	6	0.063	0.027	0.065	0.037	<0.020
WVMT-64-{6.7}	<1	10	<5	0.051	0.045	0.078		<0.020
WVMT-68				0.066	0.036		0.031	0.0021
WVMT-75-{16.2}	<1	73	8	0.140	0.052	0.160	0.044	0.024
WVMT-79-{0.9}	<1	66	7	0.073	0.052	0.085	0.075	<0.020
WVMT-81-{0.8}	<1	66	6	0.063	0.040	0.075	0.055	<0.020

Table A-8b. Additional water quality parameters taken from a subset of all streams sampled

Stream Code	Total Phos (mg/L)	NH3-N (mg/L)	NO2+NO3-N (mg/L)	TSS (mg/L)	Chloride (mg/L)	Ca-Tot (mg/L)	Ca-Dis (mg/L)	Mg (mg/L)
WVM-27-{115.0}	<0.02	<0.5	0.22	6	3	17.000	14.760	2.200
WVM-27-{83.0}	0.04	<0.50	0.40	17	3	15.000	12.000	2.100
WVM-27-{93.6}	<0.02	<0.50	0.32	5	3	13.000	13.020	1.800
WVMT-4				6	6	160.000		7.200
WVMT-5				<5	5	21.000		4.200
WVMT-7	<0.02	<0.5	0.20	<5	4	11.000	11.050	2.500
WVMT-8				6	6	16.000	13.090	2.900
WVMT-11-{6.6}	<0.02	<0.5	0.19	<5	2	33.000	29.660	4.900
WVMT-12-{10.2}	<0.02	2.2	1.2	<5	4	51.000	24.400	16.000
WVMT-18-{9.6}	<0.02	<0.50	0.21	<5	<1	8.500	7.494	1.600
WVMT-18-E-{0.4}	<0.02	<0.5	0.21	<5	4	36.0	35.980	9.5
WVMT-18-E-3-A-{1.2}	<0.02	<0.50	0.20	8	<1	21.000	21.670	4.100
WVMT-18-G-2	<0.02	<0.50	0.15					
WVMT-22				<5		16.69	14.610	2.62
WVMT-23	<0.02	<0.50	0.28					
WVMT-23-C-{5.6}	<0.02	<0.50	0.41	5	2	12.000	10.650	2.200
WVMT-23-F	<0.02	<0.50	0.09					
WVMT-24-C					5			
WVMT-24-C-1.5-A	<0.02	<0.50	<0.05		2			
WVMT-24-C-2				22	7	17.70	16.920	3.51
WVMT-24-C-3.5				10		8.65	7.425	2.06
WVMT-26-{0.4}	<0.02	<0.5	1.3	<5	49	120.000	109.800	28.000
WVMT-26-B	<0.02	0.6	1.1		110			
WVMT-31-{6.6}	<0.02	<0.50	0.53	<5	6	22.000	22.520	4.800
WVMTB-7-A-{0.5}	<0.02	<0.50	0.41	16	7	17.000	15.860	2.700
WVMTB-7-A-{2.9}	<0.02	<0.50	0.21	<5	9	15.000	13.520	2.600
WVMTB-7-C-{0.32}	<0.02	<0.5	0.08	6	<1	7.700	7.407	1.900
WVMTB-18-{11.2}	<0.02	<0.50	0.17	10	5	14.000	13.080	2.800
WVMTB-18-B-3	0.02	<0.5	0.20					
WVMTB-18-D-{3.9}	<0.02	<0.50	0.29	<5	3	8.000	8.215	1.400
WVMTB-19-{0.9}	<0.02	<0.5	0.25	6	7	13.000	12.050	2.500
WVMTB-25-A				<5		12.76	12.620	3.76
WVMTB-31-F-1				6		2.36	2.567	0.81
WVMTB-31-F-2-{0.8}	<0.02	<0.50	0.27	7	2	8.000	8.171	1.200
WVMTB-31-F-5				5		1.68	2.101	0.74
WVMTB-32-I-1	<0.02	<0.5	0.27	<5	<1	1.600	1.388	0.500
WVMT-33-{11.8}	<0.02	<0.5	0.35	<5	2	12.000	9.179	2.100
WVMTM-0.5-{0.6}	<0.02	<0.50	0.24	17	7	12.000	11.210	1.500
WVMTM-1				<5		4.62	4.528	1.01
WVMTM-3				<5	16			
WVMTM-7				60				
WVMTM-11-{0.3}	<0.02	<0.5	0.22	<5	2	15.000	12.090	1.400
WVMTM-11-{7.6}	<0.02	<0.50	0.26	<5	1	24.000	22.470	1.600
WVMTM-13-{0.8}				<5		20.71	18.580	3.0
WVMTM-25-{1.5}	<0.02	<0.5	0.34	<5	1	4.700	3.932	0.980
WVMT-35.5	0.04	<0.5	0.19					
WVMT-37-{2.8}	<0.02	<0.50	0.09	8	<1	36.000	32.830	11.000
WVMT-40-{0.6}				53		14.12	12.360	2.74
WVMT-41-{1.0}	0.06	<0.5	0.11	<5	4	5.900	68.090	1.500
WVMT-42-{7.7}	<0.02	<0.50	0.49	<3	2	27.000	25.760	13.000
WVMT-42-{7.7}	<0.02	<0.50	0.49	<3	2	27.000	25.760	13.000
WVMT-42-B-1-{1.3}	<0.02	<0.5	0.22	<5	3	160.000	18.580	27.000

Table A-8b. Additional water quality parameters taken from a subset of all streams sampled (continued)

Stream Code	Total Phos (mg/L)	NH3-N (mg/L)	NO2-NO3-N (mg/L)	TSS (mg/L)	Chloride (mg/L)	Ca-Tot (mg/L)	Ca-Dis (mg/L)	Mg (mg/L)
WVMT-43-{13.2}	0.05	<0.5	0.22	9	2	9.400	8.052	1.800
WVMT-43-{15.6}	<0.02	<0.50	0.16	8	2	6.300	5.672	1.400
WVMT-43-M				<5		13.67	13.670	1.65
WVMT-43-O				<5		3.10	3.877	1.13
WVMT-45				<5		22.15	21.710	3.04
WVMT-48	<0.02	<0.50	0.14	6	5	12.000	11.210	3.000
WVMT-50				<5		11.30	11.210	1.86
WVMT-57-{0.4}	<0.02	<0.50	0.34	<5	2	10.000	9.483	2.200
WVMT-61-{2.0}	<0.02	<0.5	0.51	<5	1	9.400	8.632	1.600
WVMT-64-{6.7}	<0.02	<0.5	0.39	<5	<1	3.800	3.378	0.820
WVMT-66	<0.02		0.31					
WVMT-68				<5		16.000	13.680	2.306
WVMT-75-{16.2}	<0.02	<0.50	0.69	<5	<1	26.000	25.830	2.400
WVMT-79-{0.9}	<0.02	<0.5	0.55	<5	<1	23.000	22.300	2.500
WVMT-81-{0.8}	<0.02	<0.5	0.45	<5	<1	24.000	21.000	2.400

Table A-8c. Additional water quality parameters taken from a subset of all streams sampled

Stream Code	Cr (mg/L)	Cu (mg/L)	Pb-Tot (mg/L)	Pb-Dis (mg/L)	Ni (mg/L)	Zn (mg/L)
WVM-27-{115.0}	<0.001	<0.005		<0.002	0.007	0.053
WVM-27-{83.0}	<0.001	0.0097		<0.002	<0.003	0.061
WVM-27-{93.6}	0.003	0.0099		0.002	0.003	0.029
WVMT-4		<0.005				0.110
WVMT-5		<0.005				0.084
WVMT-7	<0.001 (dis)	<0.0050		<0.002	<0.003 (dis)	0.024
WVMT-8	0.001 (dis)	<0.005		<0.002	<0.003 (dis)	0.062
WVMT-11-{6.6}	0.001	<0.005		0.002	<0.003	0.340
WVMT-12-{10.2}	<0.001	0.019		0.002	0.058	0.270
WVMT-18-{9.6}	0.001	0.0096		<0.002	<0.003	0.035
WVMT-18-E-{0.4}	0.003 (dis)	0.019		0.002	0.076 (dis)	0.2
WVMT-18-E-3-A-{1.2}	<0.001	0.010		<0.002	<0.003	0.110
WVMT-22	0.001	0.002	<0.002	<0.002	<0.003	0.007
WVMT-23-C-{5.6}	0.001	0.010		<0.002	<0.003	0.066
WVMT-24-C-2	<0.001	0.002	<0.002	<0.002	<0.003	0.007
WVMT-24-C-3.5	<0.001	0.003	0.002	0.002	<0.003	0.01
WVMT-26-{0.4}	0.001	<0.005		<0.002	<0.003	0.083
WVMT-31-{6.6}	0.001	<0.005		0.002	<0.003	0.062
WVMTB-7-A-{0.5}	<0.001 (dis)	0.0075		<0.002	<0.003 (dis)	0.025
WVMTB-7-A-{2.9}	<0.001 (dis)	0.0065		<0.002	<0.003 (dis)	0.021
WVMTB-7-C-{0.32}	<0.001 (dis)	0.0066		<0.002	<0.003 (dis)	0.130
WVMTB-18-{11.2}	<0.001 (dis)	0.0069		<0.002	<0.003 (dis)	0.027
WVMTB-18-D-{3.9}	0.001 (dis)	0.0070		0.004	<0.003 (dis)	<0.020
WVMTB-19-{0.9}	<0.001 (dis)	0.0071		<0.002	<0.003 (dis)	0.020
WVMTB-25-A	<0.001	0.001	<0.002	<0.002	<0.003	0.036
WVMTB-31-F-1	<0.001	0.001	<0.002	<0.002	0.009	0.006
WVMTB-31-F-2-{0.8}	0.004 (dis)	0.0068		<0.002	<0.003 (dis)	<0.020
WVMTB-31-F-5	<0.001	0.004	0.002	<0.002	<0.003	0.018
WVMTB-32-I-1	<0.001 (dis)	0.0065		<0.002	0.003 (dis)	0.049
WVMT-33-{11.8}	<0.001	<0.005		<0.002	<0.003	0.083
WVMTM-0.5-{0.6}	<0.001 (dis)	<0.0050		<0.002	<0.003 (dis)	0.076
WVMTM-1	<0.001	0.002	<0.003	<0.003	<0.003	0.007
WVMTM-11-{0.3}	<0.001 (dis)	<0.0050		<0.002	<0.003 (dis)	0.046
WVMTM-11-{7.6}	<0.001 (dis)	0.0062		<0.002	<0.003 (dis)	0.033
WVMTM-13-{0.8}	<0.001	0.002	<0.002	<0.002	0.005	0.008
WVMTM-25-{1.5}	<0.001 (dis)	<0.005		0.006	<0.003 (dis)	0.047
WVMT-37-{2.8}	<0.001	0.0061		<0.002	0.015	0.061
WVMT-40-{0.6}	<0.001	0.002	<0.002	<0.002	0.003	0.014
WVMT-41-{1.0}	0.004	0.0056		<0.002	0.188	0.028
WVMT-42-{7.7}	0.001	0.0058		<0.002	0.044	0.140
WVMT-42-{7.7}	0.001	0.0058		<0.002	0.044	0.140
WVMT-42-B-1-{1.3}	0.003	0.012		0.002	0.307	0.084
WVMT-43-{13.2}	<0.001	0.0062		<0.002	<0.003	0.057
WVMT-43-{15.6}	<0.001	0.0087		<0.002	<0.003	0.033
WVMT-43-M	<0.001	0.002	<0.002	<0.002	<0.003	0.023
WVMT-43-O	<0.001	0.003	<0.002	<0.002	<0.003	0.011
WVMT-45		0.003				0.009
WVMT-48	<0.001 (dis)	0.012		<0.002	<0.003 (dis)	0.037
WVMT-50		0.002				0.018
WVMT-57-{0.4}	0.001 (dis)	0.0091		0.002	<0.003 (dis)	0.052
WVMT-61-{2.0}	0.001	0.0056		<0.002	<0.003 (dis)	0.083
WVMT-64-{6.7}		0.0051				0.025
WVMT-68	<0.001	0.002		<0.002	<0.003	0.009 (dis)
WVMT-75-{16.2}	<0.001 (dis)	0.0055		0.002	0.003 (dis)	<0.020
WVMT-79-{0.9}	0.001 (dis)	0.0059		<0.002 (dis)	<0.003 (dis)	0.021
WVMT-81-{0.8}	<0.001 (dis)	<0.005		<0.002	<0.003 (dis)	<0.020

Table A-9. Rapid Habitat Assessment Scores

Stream Code	cover	substrate	embed	veloc	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	grazing	rip veg	**Total**
WVM-27-{115.0}	17	18	13	20	20	6	11	8	15	18	12	1	**159**
WVM-27-{46.2}	7	14	10	10	12	8	17	14	15	7	17	4	**135**
WVM-27-{83.0}	15	15	13	12	16	14	8	16	16	6	16	4	**151**
WVM-27-{93.6}	8	10	9	12	19	11	6	16	10	5	11	4	**121**
WVMT-4	11	16	8	11	14	11	19	11	13	16	15	12	**157**
WVMT-5	19	17	17	17	20	16	16	14	18	20	17	14	**205**
WVMT-7	14	16	11	14	17	11	16	10	15	18	14	10	**166**
WVMT-8	17	16	14	18	11	15	13	15	18	14	19	3	**173**
WVMT-11-{6.6}	14	17	12	13	7	9	16	11	13	9	13	0	**135**
WVMT-11-A	6	7	8	11	12	5	8	12	12	12	13	7	**113**
WVMT-11-B	7	9	3	7	12	7	2	14	12	16	13	6	**108**
WVMT-11-B-1	5	7	6	6	16	6	1	13	16	11	16	3	**106**
WVMT-12-{10.2}	17	17	14	10	19	15	14	16	15	9	15	7	**168**
WVMT-18-{9.6}	12	11	3	6	17	7	9	15	12	10	13	3	**118**
WVMT-18-E-{0.4}	8	7	11	16	18	12	7	17	11	18	12	7	**144**
WVMT-18-E-3-A-{1.2}	10	11	14	10	18	14	15	9	14	15	17	8	**155**
WVMT-18-E-4-A	18	18	13	10	14	13	18	10	14	5	16	5	**154**
WVMT-18-G-2	18	18	9	9	14	13	18	15	12	4	13	3	**146**
WVMT-22	10	14	10	9	18	13	18	6	18	11	18	6	**151**
WVMT-23	19	15	17	17	18	17	18	11	16	11	16	5	**180**
WVMT-23-B-1	13	12	16	9	13	12	12	8	12	10	16	8	**141**
WVMT-23-C-{5.6}	18	19	14	14	18	16	18	13	14	9	15	3	**171**
WVMT-23-F	13	17	13	9	14	17	18	16	13	6	17	5	**158**
WVMT-24-{0.03}	18	15	11	16	18	11	18	13	17	17	13	16	**183**
WVMT-24-A	16	8	12	8	14	11	16	11	13	6	14	5	**134**
WVMT-24-C	10	5	10	8	15	16	10	10	16	8	18	5	**131**
WVMT-24-C-1.5-A	10	10	9	5	17	12	15	8	10	3	15	2	**116**
WVMT-24-C-2	7	8	13	7	14	15	8	8	11	5	14	5	**115**
WVMT-24-C-3.5	15	11	12	11	15	9	16	13	9	15	11	10	**147**
WVMT-26-{0.4}	10	11	10	17	12	16	11	16	11	5	13	0	**132**
WVMT-26-B	11	12	6	7	13	12	7	14	14	6	14	4	**120**
WVMT-26-C	3	3	15	5	11	6	5	16	14	5	17	5	**105**
WVMT-29	11	16	11	9	11	8	18	12	8	7	13	4	**128**
WVMT-31-{6.6}	16	16	15	12	16	15	11	16	16	6	16	2	**157**
WVMTB-1	16	16	6	10	10	14	17	14	16	7	16	5	**147**
WVMTB-5	15	13	14	9	15	14	16	15	16	7	16	4	**154**
WVMTB-5-B	16	16	14	5	14	10	7	16	17	6	17	1	**139**
WVMTB-5-C	9	8	8	8	16	6	8	12	10	8	6	8	**107**
WVMTB-7-{1.0}	14	15	15	15	14	9	14	9	16	13	11	9	**154**
WVMTB-7-A-{0.5}	13	9	16	15	19	13	13	9	18	14	16	12	**167**
WVMTB-7-A-{2.9}	17	16	14	10	11	8	12	9	13	6	9	4	**129**
WVMTB-7-C-{0.32}	11	12	16	9	19	11	16	9	9	13	15	8	**148**
WVMTB-8	16	16	15	10	15	14	17	15	11	6	10	4	**149**
WVMTB-9	12	12	11	10	18	10	15	16	13	17	3	14	**151**
WVMTB-10-A	9	14	13	14	14	11	15	16	14	5	13	4	**142**
WVMTB-11	9	13	10	14	12	9	5	14	10	9	3	11	**119**
WVMTB-11-B	7	11	11	13	13	6	6	14	10	17	15	14	**137**
WVMTB-11-B.5	10	11	8	9	13	9	11	12	12	5	14	4	**118**
WVMTB-11-B.7	11	14	8	10	18	15	16	12	13	14	15	6	**152**
WVMTB-18-{11.2}	15	14	14	16	18	8	7	12	14	18	10	17	**163**
WVMTB-18-B	11	11	13	10	12	10	13	14	15	13	16	5	**143**
WVMTB-18-B-2	10	15	9	10	8	8	12	13	14	15	12	17	**143**

Table A-9. Rapid Habitat Assessment Scores (continued)

Stream Code	cover	substrate	embed	veloc	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	grazing	rip veg	**Total**
WVMTB-18-B-3	4	8	9	8	18	7	7	15	18	10	16	3	**123**
WVMTB-18-D-{3.9}	19	10	17	14	19	12	17	9	19	18	17	10	**181**
WVMTB-19-{0.9}	12	10	14	10	19	15	13	9	13	19	16	18	**168**
WVMTB-20	17	13	15	12	12	17	17	10	15	12	17	5	**162**
WVMTB-24	14	10	11	10	19	15	15	15	13	11	15	6	**154**
WVMTB-25	14	16	9	14	15	12	16	14	11	8	11	7	**147**
WVMTB-25-A	16	16	15	9	16	15	18	12	17	9	16	7	**166**
WVMTB-27	16	10	11	13	17	6	16	6	9	11	13	9	**137**
WVMTB-28	16	13	12	10	10	15	16	10	13	17	16	12	**160**
WVMTB-29	18	13	19	10	14	13	16	5	17	15	19	16	**175**
WVMTB-30	15	14	17	10	19	12	16	8	18	19	17	19	**184**
WVMTB-31	18	18	15	15	18	17	18	10	14	18	14	14	**189**
WVMTB-31-C	15	18	16	10	18	19	17	9	17	16	17	16	**188**
WVMTB-31-D	16	14	17	10	19	15	17	8	18	18	17	14	**183**
WVMTB-31-F-1	17	16	12	10	17	11	16	10	12	14	17	10	**162**
WVMTB-31-F-2-{0.8}	17	17	15	10	18	16	17	8	15	5	17	3	**158**
WVMTB-31-F-5	9	16	17	10	7	18	17	6	8	16	7	9	**140**
WVMTB-31-J	17	17	13	14	18	16	18	15	16	18	18	14	**194**
WVMTB-32-{0.4}	14	18	15	15	15	14	19	10	16	17	14	17	**184**
WVMTB-32-{0.4}	16	15	13	14	15	15	16	12	13	10	15	8	**162**
WVMTB-32-D	16	17	14	13	15	16	18	11	15	16	15	15	**181**
WVMTB-32-H	18	19	16	10	18	15	19	13	12	18	13	16	**187**
WVMTB-32-I-1	15	19	14	10	19	15	18	11	17	20	17	20	**195**
WVMT-33-{11.8}	16	17	13	18	18	16	19	18	14	18	15	11	**193**
WVMTM-0.5-{0.6}	17	18	15	14	15	14	18	16	17	15	17	15	**191**
WVMTM-1	17	13	11	12	18	12	16	14	16	15	15	14	**173**
WVMTM-2	18	17	16	12	15	15	14	17	14	10	11	5	**164**
WVMTM-3	16	19	11	9	7	15	18	18	16	6	17	1	**153**
WVMTM-5	17	16	15	10	19	14	16	10	14	11	14	5	**161**
WVMTM-7	17	18	16	12	11	11	17	10	15	18	8	13	**166**
WVMTM-11-{0.3}	18	15	15	14	17	10	18	17	14	13	15	10	**176**
WVMTM-11-{7.6}	19	18	16	15	20	16	18	15	15	19	15	20	**206**
WVMTM-11-E	18	18	16	15	17	16	16	17	15	15	15	13	**191**
WVMTM-13-{0.8}	13	17	14	10	15	10	15	14	14	8	14	1	**145**
WVMTM-17	15	14	11	8	6	7	16	8	17	11	10	3	**126**
WVMTM-21	17	18	14	10	18	14	18	9	14	15	15	5	**167**
WVMTM-25-{1.5}	19	19	18	14	19	15	19	15	11	19	11	20	**199**
WVMTM-25-A	19	19	18	10	19	18	19	11	14	19	10	18	**194**
WVMTM-26-B	19	16	16	13	19	15	17	15	14	19	14	20	**197**
WVMTM-27	18	18	15	6	11	13	19	6	9	8	9	13	**145**
WVMT-35.5	6	7	15	6	10	10	8	16	16	5	16	1	**116**
WVMT-36	16	14	14	10	18	14	15	9	15	17	13	17	**172**
WVMT-37-{0.0}	15	13	16	14	14	15	14	8	9	17	9	15	**159**
WVMT-37-{2.8}	15	14	12	10	20	12	17	9	8	18	9	10	**154**
WVMT-38-A	15	18	15	3	16	14	19	4	16	13	16	11	**160**
WVMT-40-{0.4}	19	16	16	14	19	14	17	6	18	19	18	19	**195**
WVMT-40-{0.6}	18	16	13	14	19	12	17	7	16	19	12	20	**183**
WVMT-40-A	15	15	15	10	19	14	16	6	19	19	13	19	**180**
WVMT-41-{1.0}	11	10	10	10	3	9	8	16	15	6	15	3	**116**
WVMT-42-{7.7}	13	11	8	14	19	13	9	18	4	7	7	2	**119**
WVMT-42-{7.7}	11	13	12	9	17	7	6	16	11	8	8	3	**108**
WVMT-42-B-1-{1.3}	6	12	4	7	15	8	11	17	16	15	16	15	**142**

Table A-9. Rapid Habitat Assessment Scores (continued)

Stream Code	cover	substrate	embed	veloc	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	grazing	rip veg	**Total**
WVMT-43-{13.2}	16	13	12	18	19	16	17	16	13	17	15	6	**178**
WVMT-43-{15.6}	13	16	13	10	16	13	13	16	15	7	15	2	**149**
WVMT-43-A	6	11	4	8	10	5	11	16	8	7	12	3	**101**
WVMT-43-F-1	16	18	15	9	17	15	18	16	15	6	15	2	**162**
WVMT-43-H	7	7	6	5	18	9	11	13	8	7	11	4	**106**
WVMT-43-M	15	17	15	9	14	15	17	17	13	2	14	2	**150**
WVMT-43-O	11	12	10	9	15	11	12	16	10	6	10	3	**125**
WVMT-45	13	11	17	13	19	17	15	15	17	10	19	11	**177**
WVMT-48	12	15	15	10	19	14	18	15	13	17	18	10	**176**
WVMT-50	19	18	14	18	9	14	16	15	16	4	15	2	**160**
WVMT-50-A-1	16	17	12	10	16	17	18	13	14	7	18	5	**163**
WVMT-50-B-3	15	17	18	16	20	13	19	15	18	16	15	14	**196**
WVMT-57-{0.4}	14	16	14	8	18	15	16	16	15	14	15	14	**175**
WVMT-61-{2.0}	13	18	15	14	10	10	19	10	18	18	11	5	**161**
WVMT-64-{6.7}	19	17	18	16	19	15	18	10	17	19	15	18	**201**
WVMT-64-A.5	15	19	16	12	12	10	18	8	12	11	12	0	**145**
WVMT-64-C	17	18	17	10	19	15	18	10	11	20	10	19	**184**
WVMT-64-E	19	18	18	10	15	15	19	9	15	19	16	17	**190**
WVMT-64-F	11	13	17	15	16	15	17	10	16	10	13	4	**157**
WVMT-66	18	18	16	17	5	10	17	7	19	11	3	0	**141**
WVMT-66-B	16	18	11	16	6	6	17	6	3	5	1	0	**105**
WVMT-68	18	15	12	20	15	12	16	12	16	18	15	5	**174**
WVMT-68-D	18	17	17	8	18	16	18	9	15	10	15	3	**164**
WVMT-69	18	17	14	10	17	16	18	9	13	4	12	1	**149**
WVMT-74	18	12	15	8	17	13	17	9	15	7	16	1	**148**
WVMT-74-B-1	18	15	11	10	16	13	18	9	13	12	16	3	**154**
WVMT-75-{16.2}	18	18	15	10	19	10	18	10	14	15	14	9	**170**
WVMT-78	18	15	17	10	13	15	18	13	12	3	4	0	**138**
WVMT-79-{0.9}	18	14	17	10	15	16	18	10	15	18	18	5	**174**
WVMT-81-{0.8}	17	12	11	8	18	16	16	10	16	10	16	2	**152**

Categories scored 0-20, total possible score = 240

cover = instream cover
substrate = epifaunal substrate
embed = embeddedness
veloc = # of velocity/depth regimes (i.e. fast / shallow)
alter = channel alteration
sediment = sediment deposition
riffle freq. = frequency of riffles
flow = channel flow
bank stab = erosional condition of banks
bank veg = vegetative protection
grazing = grazing or other disruptive pressure
rip veg = riparian vegetation zone width (least buffered side)

Appendix B. Glossary

303(d) list -a list of streams that are water quality limited and not expected to meet water quality criteria even after applying technology-based controls. Required by the Clean Water Act and named for the section of the Act in which it appears.

acidity -the capacity of water to donate protons. The abbreviation pH (see definition below) refers to degree of acidity. Higher acidities are more corrosive and harmful to aquatic life.

acid mine drainage (AMD) -acidic water discharged from an active or abandoned mine.

alkalinity -measures water's buffering capacity, or resistance to acidification; often expressed as the concentration of carbonate and bicarbonate.

aluminum -a potentially toxic metallic element often found in mine drainage; when oxidized it forms a white precipitate called "white boy".

ArcView - a brand of Geographic Information System computer software.

benthic macroinvertebrates - small animals without backbones yet still visible to the naked eye, that live on the bottom (the substrate) of a water body and are large enough to be collected with a 595 micron mesh screen. Examples include insects, snails, and worms.

benthic organisms, or benthos - organisms that live on or near the substrate (bottom) of a water body (e.g., algae, mayfly larvae, darters).

buffer -a dissolved substance that maintains a solution's original pH by neutralizing added acid.

canopy -The layer of vegetation that is more than 5 meters from the ground; see understory and ground cover.

cfs - cubic feet per second, a measurement unit of stream discharge.

citizens monitoring team -a group of people that periodically check the ecological health of their local streams.

conductivity (conductance) -the capacity of water to conduct an electrical current, higher conductivities indicate higher concentrations of ions.

CR - County Route.

DEP - Division of Environmental Protection. A unit of the executive branch of West Virginia's state government charged with enforcing environmental laws and monitoring environmental quality.

designated uses -the uses specified in the state water quality standards for each water body or segment (e.g., fish propagation or industrial water supply).

discharge -liquid flowing from a point source; or the volume of water flowing down a stream per unit of time, typically recorded as cfs (cubic feet per second).

discharge permit -a legal document issued by a government regulatory agency specifying the kinds and amounts of pollutants a person or group may discharge into a water body; often called NPDES permit.

dissolved oxygen (DO) - the amount of molecular oxygen dissolved in water, normally expressed in mg/L.

DNR - Department of Natural Resources. A unit of the executive branch of West Virginia state government charged with protecting and regulating the use of wildlife, fish and their habitats.

DWWM - Division of Water and Waste Management. A unit within the DEP that manages a variety of regulatory and voluntary activities to enhance and protect West Virginia's surface and ground waters.

ecoregion -a land area with relative homogeneity in ecosystems that, under unimpaired conditions, contain habitats which should support similar communities of animals (specifically macrobenthos).

ecosystem -the complex of a community and its environment functioning as an ecological unit in nature. A not easily defined aggregation of biotic and abiotic components that are interconnected through various trophic pathways, and that interact systematically in the transfer of nutrients and energy.

effluent -liquid flowing from a point source (e.g., pipe or collection pond).

Environmental Protection Agency (EPA) -a unit in the executive branch of the federal government charged with enforcing environmental laws.

Environmental Quality Board (EQB) -a standing group, whose members are appointed by the governor, that promulgates water quality criteria and judges appeals for relief from water quality regulations.

EPA - Environmental Protection Agency (see definition above).

ephemeral -a stream that carries surface water during only part of the year; a stream that occasionally dries up.

EQB - Environmental Quality Board (see definition above).

eutrophic -a condition of a lake or stream which has higher than normal levels of nutrients, contributing to excessive plant growth. Consequently more food and cover is provided to some macrobenthos than would be provided otherwise. Usually eutrophic waters are seasonally deficient in oxygen.

fecal coliform bacteria -a group of single-celled organisms common in the alimentary tracts of some birds and all mammals, including man; indicates fecal pollution and the potential presence of human pathogens.

GIS - Geographic Information System. Computer programs that allow for the integration and manipulation of spatially anchored data.

GPS - geographic positioning system.

ground cover -vegetation that forms the lowest layer in a plant community defined as less than 0.5 meters high for this assessment .

impaired -as used in this assessment report, a benthic macroinvertebrate community with metric scores substantially worse than those of an appropriate reference site. The total WVSCI score is equal to or less than 60.6.

iron -a metallic element, often found in mine drainage, that is potentially harmful to aquatic life. When oxidized, it forms an orange precipitate called “yellow boy” that can clog fish and macroinvertebrate gills.

lacustrine - of or having to do with a lake or lakes.

MACS -Mid-Atlantic Coastal Streams -macrobenthic sampling methodology used in streams with very low gradient that lack riffle habitat suitable for The Section’s preferred procedure.

manganese -a metallic element, often found in mine drainage, that is potentially harmful to aquatic life.

metrics -statistical tools used by ecologists to evaluate biological communities

National Pollutant Discharge Elimination System (NPDES) -a government permitting activity created by section 402 of the federal Clean Water Act of 1972 to control all discharges of pollutants from point sources. In West Virginia this activity is conducted by the Division of Water Resources.

N/C - not comparable.

nonpoint source (NPS) pollution -contaminants that run off a broad landscape area (e.g., plowed field, parking lot, dirt road) and enter a receiving water body.

Oligotrophic - a stream, lake or pond which is poor in nutrients.

Palustrine - of or having to do with a marsh, swamp or bog.

pH -indicates the concentration of hydrogen ions; a measure of the intensity of acidity of a liquid. Represented on a scale of 0-14, a pH of 1 describes the strongest acid, 14 represents the strongest base, and 7 is neutral. Aquatic life cannot tolerate either extreme.

point source -a specific, discernible site (e.g., pipe, ditch, container) locatable on a map as a point, from which pollution discharges into a water body.

RBP - Rapid Bioassessment Protocol. Relatively quick methods of comparatively assessing biological communities.

reference site -a stream reach that represents an area's (watershed or ecoregion) least impacted condition; used for comparison with other sites within that area. Site must meet the agency's minimum degradation criteria.

SCA -Soil Conservation Agency.

Section - The Watershed Assessment Section of the WV Division of Water Resources.

SPOT image - a geographic information system coverage layer that mimics black and white satellite imagery.

stakeholder -a person or group with a vested interest in a watershed, e.g., landowner, business person, angler.

STORET -**STO**rage and **RET**rieval of U.S. waterways parametric data -a system maintained by EPA and used by DWWM to store and analyze water quality data.

total maximum daily load (TMDL) -the total amount of a particular pollutant that can enter a water body and not cause a water quality standards violation.

turbidity -the extent to which light passes through water, indicating its clarity; indirect measure of suspended sediment.

understory -the layer of vegetation that form a forest's middle layer (defined as 0.5 to 5 meters high for this assessment).

unimpaired -as used in this assessment report, a benthic community with metric scores similar to those of an appropriate reference site. Total WVSCI score greater than 68.0.

USGS -United States Geological Survey.

water-contact recreation -the type of designated use in which a person (e.g., angler, swimmer, boater) comes in contact with the stream's water.

watershed -a geographic area from which water drains to a particular point.

Watershed Approach Steering Committee -a task force of federal (e.g., U.S. Environmental Protection Agency, US Geological Survey) and state (e.g., Division of Environmental Protection, Soil Conservation Agency) officers that recommends streams for intense, detailed study.

Watershed Assessment Section (the Section) -a group of scientists within the DWWM charged with evaluating and reporting on the ecological health of West Virginia's watersheds.

watershed association -a group of diverse stakeholders working via a consensus process to improve water quality in their local streams.

Watershed Network -an informal coalition of federal, state, multi-state, and non-governmental groups cooperating to support local watershed associations.

WCMS - Watershed Characterization and Modeling System, an ArcView-based GIS program developed by the Natural Resource Analysis Center of West Virginia University.