Multi-agency Analysis of Periphyton, Fish, and Benthic Macroinvertebrate Communities and the Effects of Point and Non-point Sources in the Indian Creek Watershed, Tazewell County, Virginia

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EXECUTIVE SUMMARY

Chemical, physical, and biological indices were used in this study. Water and sediment samples were analyzed for EPA's priority pollutants. Other measurements such as total suspended solids, total dissolved solids, total organic carbon and grain size, fecal coliform, dissolved oxygen, pH, acid volatile sulfides, ammonia, nitrogen, and phosphorus were also conducted. Contaminant concentrations and water quality parameters were compared to water quality standards and sediment guidelines. Macroinvertebrate, fish, and periphyton communities were evaluated using a systematic sampling and analysis of indicators of stream quality (index of biological integrity [IBI] for fish and rapid bioassessment protocol [RBP] for benthic macroinvertebrates).

This study represents a collaborative effort between many agencies. The FWS had overall project lead and participated in each of the components of the study. The Virginia Coal Association (VCA) partnered with the FWS on the water quality and chemical analysis. Pennington and Associates, Inc. conducted the periphyton sampling. The U.S. Environmental Protection Agency (EPA) and FWS conducted benthic macroinvertebrate surveys, and the EPA conducted the analysis of the data. The Tennessee Valley Authority, Virginia Department of Game and Inland Fisheries, and FWS conducted the fish surveys and IBI.

Complementing this text report, is a disc that contains the Geographic Information System (GIS) database. This database was created to incorporate the data collected for the Indian Creek watershed study. The base layers were taken from the FWS "office-based" GIS system, developed in cooperation with the Conservation Management Institute at Virginia Tech using ESRI's (Environmental Systems Research Institute) ArcGIS 8.3 software. The base layers in were: historic and current coal mine information; hydrology; counties; cities; digital raster graphics (7.5 minute topographic maps - USGS - United States Geological Survey); digital orthographic quarter quads (USGS); and 30 meter digital elevation model (USGS).

Sample site locations were mapped using GPS (Global Positioning System) data collected in the field and verified through the use of topographic features. GPS data was collected using a PLGR (Precision Lightweight GPS Receiver) built by Rockwell. A geodatabase was created relating the sites to eighteen data tables containing physical, biological, and analytical data (Algae_Species, Benthic_Sites, Benthic_Stream_Characteristics, Benthic_Taxa, Chlorophyll, Fecal_Coliform, Fish_IBI_Scores, Fish_Species, Habitat Score, Hydrolab_Data, Periphyton_Species, Periphyton_Stream_Characteristics, Periphyton_Summary, SED_2001, SED_2002, Surface_Water_2001, Surface_Water_2002, VSCI Scores). Additional data produced by screen digitization includes: NPDES (Non-Point Discharge Elimination System) discharge permits - non-coal related and Individual Treatment Units (data obtained from Virginia Department of Environmental Quality); and area of site drainage for each individual sample site and for the complete Indian Creek Watershed.

Results of the integrated biological monitoring program for Indian Creek found that healthy biological communities, excellent habitat and water quality are present at many of the sampling stations. Results where patterns of impairment were evident, based on water quality, RBP, and IBI, point to areas of concern at several sites where future monitoring may be warranted. One of

the most exciting finds of this study was a dace, (*Phoxinus sp., cf. saylori*), that was initially thought to be the laurel dace (*Phoxinus saylori*), a rare fish species. Chris Skelton, Georgia College and State University, is doing genetics testing for determination. If it is not the laurel dace, it is a new undescribed species.

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INTRODUCTION

The Clinch and Powell Rivers originate in southwestern Virginia, and flow into the upper reaches of the Tennessee River. While all of the mainstream Tennessee River and many of its tributaries have been dammed, resulting in the loss of habitat for many fish and mussel species (Yeager 1994), the Upper Clinch and Powell Rivers represent some of the last free-flowing sections of the expansive Tennessee River system. The upper region of the Clinch River drains approximately 2,912 square miles (7,542 square kilometers). The Clinch River begins in Tazewell County, Virginia, and flows for approximately 200 miles (321.9 km) before reaching Norris Lake in Tennessee. The Clinch and Powell drainages have the greatest number of federally listed endangered aquatic species (Table 1) and also the largest concentration of endemic species in the United States for an area of this size.

The Southeast has the highest diversity of freshwater fishes in the United States (Etnier and Starnes 1994). These obligate riverine fishes have historically existed in relatively stable environments (Jenkins and Burkhead 1994), but this has changed rapidly over the past century. Some species are not able to withstand the physical and chemical alterations to their habitats that have occurred due to anthropogenic pressures in the watershed (Yeager, 1994). As a result, local extirpations and extinctions have taken place. The Nature Conservancy recognized the global importance of this ecosystem and designated protection of the UTRB as one of their organization's national priorities, due to the presence of rare mussels, fish, and other species. About 30 percent of the federally listed endangered fish species, and 40 percent of the species that are proposed candidates for listing, are located in the Southeast. Of the 85 fish species reported from these systems, about one-third are federally listed as endangered or threatened, are candidates for listing, or are listed for protection by Tennessee or Virginia. In the upper Clinch River watershed, there are two federally listed fish species (Table 2). Sedimentation is a potentially strong stressor to native fish populations in this system because it reduces suitable spawning sites and, thereby, fish recruitment. This stressor originates from a number of sources including livestock watering, and soil erosion from urban, mining, and agricultural runoff, riparian corridor modification, and silviculture.

The Clinch River supports one of the greatest assemblages and diversity of freshwater mussels currently known in the world (Ortmann 1918; Ahlstedt 1991). Remnants of the unique mussel assemblage exist as fragmented populations and presently occur only in a few tributaries of the Clinch River watershed. Mussels are susceptible to any land use or natural phenomenon that: 1) reduces host fish survival and reproduction, 2) degrades water quality, 3) reduces or eliminates benthic habitat, 4) interferes with or undermines the normal filter-feeding process and or reproduction, or 5) reduces survival or establishment of juveniles. The decline in fish and mussel populations in the UTRB has been linked to changes in water quality and habitat degradation (Neves et al. 1980, Dennis 1981, Biggins 1989, Wolcott 1990, Wolcott and Neves 1992, McCann and Neves 1992). Thus, mussels are at risk from a variety of human activities in the watershed including agricultural practices, urban runoff, wastewater discharges, runoff from mining, forestry practices, roads and other transportation corridors, and possibly competition from the introduction of exotic species such as the Asiatic clam (*Corbicula fluminea*).

Although historical episodic chemical or coal slurry spills have been low in frequency in this watershed, they have had a major impact on mussel and native fish species abundance and distribution. For example, the Appalachian Power Company's Clinch River plant (Carbo, VA), located in the upstream section of the Clinch River, has been responsible for two large spills affecting downstream aquatic communities up to 30 km from the site•a spill of caustic ash in 1967 and an acid spill in 1970 (Cairns et al. 1971; Crossman et al. 1973). This stretch of river is now depauperate of mussels, despite a time span of more than 28 years. More recently, a chemical spill in 1998 at Cedar Bluff, Virginia, destroyed three species of federally listed endangered mussels, including one of the only two remaining reproducing populations of the tan riffleshell mussel, *Epioblasma walkeri* in Virginia.

The rapid decline in the unique biodiversity in the Clinch River emphasizes the need to take steps to conserve the remaining species by characterizing the sources and levels of impacts to these aquatic systems. Many federal, state, and local agencies, private conservation organizations, researchers, and concerned citizens are working to protect the resources of the area. In 1994, an upper Tennessee River basin (UTRB) aquatic studies and GIS workshop was held to address biological and water quality monitoring needs within the UTRB. More than 50 representatives from 27 agencies, universities, and the private sector attended this meeting to discuss what data was needed. Biological information needs that were identified include: 1) monitor water quality in all streams in UTRB; 2) conduct fish and benthic macroinvertebrate Index of Biotic Integrity (IBI) studies for use in stream assessments; 3) assay for pesticides/herbicides in streams adjacent to agricultural land; 4) assay for contaminants in streams adjacent to mined lands; 5) inventory biological resources below sewage treatment plants; and 6) identify factors affecting recruitment and mortality in fish and mussel populations.

In order to further the accomplishment of collective and individual goals for protection of the aquatic species in the Clinch River, the U.S. Fish and Wildlife Service (FWS) initiated a study in the Indian Creek watershed to address some of these data gaps. This watershed was selected because the portion of Clinch River from Cedar Bluff downstream to Richlands is thought to be the most important reach for mussels in the upper Clinch River (Dr. Richard Neves, personal communication; Leroy Koch, personal observations). Also, since a 1998 chemical spill, the only known reproducing population of the tan riffleshell mussel in Virginia occurs in the extreme lower portion of Indian Creek, a tributary to the Clinch River at Cedar Bluff.

CHEMICAL DATA

INTRODUCTION

The Clean Water Act passed in 1972 is responsible for surface water quality protection and through a variety of regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways to maintain the chemical, physical, and biological integrity of the nation's waters. Though the Clean Water Act has had a positive impact reducing point source pollution, it has been more difficult to quantify and control non-point source pollution. Non-point source pollution stems from a number of sources and can involve toxic chemicals, nutrients, bacteria, and sediment. Toxic chemicals typically enter the water though point sources, however, non-point sources can also contribute a considerable volume of these chemicals, i.e., herbicides and pesticides commonly used on farms and residential areas. Although nutrients are vital to aquatic life, they are a concern because large inputs of nitrogen and phosphorus compounds into the aquatic environment can cause excessive algal growth with subsequent decay. When algal blooms die, dissolved oxygen is depleted, which can stress aquatic organisms.

Altering land uses and urban developments tend to increase non-point source pollution to a watershed. Combined with changes to the natural flow of steams, considerable quantities of sediment, salts, nutrients and toxic chemicals can be released into streams, affecting the physical, biological and chemical characteristics of the watershed. Assessments of chemical concentrations serve as direct measures of stressors to aquatic life.

The primary objective of chemical analysis was to assess the occurrence of potentially toxic chemicals and nutrients in water and sediment and to evaluate the significance of the findings in order to establish baseline data, identify potential sources of contaminants, predict the likelihood of adverse effects to aquatic life, and, if need be, to focus restoration efforts in the watershed.

METHODS

Two rounds of surface water and sediment samples were collected and analyzed for priority pollutant volatile and semivolatile organics, inorganics, pesticides, polychlorinated biphenyls, herbicides, and other water quality and sediment parameters as noted below. Field sampling took place the weeks of September 10, 2001 and May 14, 2002. A map of the sampling locations is provided in Figure 2, and digital images are provided at the end of the appendices. Sediment samples were collected from 22 locations in the Indian Creek watershed in Tazewell County, Virginia (Figure 2), with one field duplicate, one trip blank (for volatile organic compound analysis), one field blank, and two matrix spike and matrix spike duplicate samples collected for quality control/quality assurance analyses (QA/QC). Grab water samples were also collected at the same locations, with one field duplicate, one trip blank, one rinsate blank, one field blank, and two matrix spike and matrix spike duplicates run for QA/QC. The laboratory also ran method blanks and spiked recoveries at a rate of one per sample batch.

A Hydrolab Surveyor 4 was used in the field to record dissolved oxygen, temperature, pH, total dissolved solid measurements, and specific conductivity in surface water during both rounds of chemical sampling, as well as throughout the year, to give a snap shot in time of seasonal variation of water quality data.

Grab water samples were sent to the Commonwealth of Virginia, Division of Consolidated Laboratory Services in Abingdon, Virginia for the fecal coliform analysis. Grab samples collected in-stream at each location were preserved in sodium thiocyanate, immediately placed on ice, and transported to the laboratory within six hours of collection to meet analytical holding times. Samples were also taken on ice to the Severn Trent's laboratory in Savannah, Georgia for chemical analysis. Chemical analysis were conducted using the standard EPA approved methodologies (Table 3).

RESULTS AND DISCUSSION

Water Quality

The summary results of the Hydrolab and chemical analyses are presented in Tables 4 and 5, and the complete analytical report for all chemical analyses is provided in the appendix. Below is a summary of significant findings.

Dissolved oxygen analysis measures the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration, and as a waste product of photosynthesis. Adequate dissolved oxygen is necessary for good water quality. The amount varies directly in response to changes in atmospheric pressure and water temperature. The higher the atmospheric pressure the higher the oxygen solubility in water and the higher the dissolved oxygen concentration. The opposite is true with temperature, the higher the temperature the lower the solubility and saturation concentration of oxygen in water. Dissolved oxygen is one of the major factors that determine the types of biological communities that inhabit an aquatic system. As dissolved oxygen levels in water drop below 5.0 milligrams per liter (mg/l), aquatic life may become stressed. Dissolved oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills. During September 2001, dissolved oxygen was good at all locations and ranged from 6.2 mg/l at site 15 to 10.9 at site 10, with an average of 8.9 mg/l for all sites. The average temperature during the September 2001 sampling for all sites was 17.9EC. Dissolved oxygen levels in May 2002 were higher than anticipated, and at some locations were well above saturation. Although the instrument was calibrated prior to field sampling, it does not appear that the results are accurate. Therefore, this data is not presented.

pH is a measure of the acidic or basic nature of a solution and is determined by the concentration of the hydrogen ion [H+] activity in a solution. A pH range of 6.0 to 9.0 provides adequate protection for aquatic life. pH was good at all sites and ranged from 6.53 at site 22 to 8.02 at site 21, with an average of 7.83 during the September 2001 sampling and 7.31 at site 13 to 8.10 at site 20, with an average of 8.01 during the May 2002 sampling.

The concentration of total suspended solids indicates the amount of particulate material in the water. With increasing particulate concentrations, light penetration is reduced, interfering with aquatic plant growth (Flanagan 1990). There are no statewide numeric criteria for total suspended solids in Virginia water quality standards, however, a standard of 5.0 mg/l, as a monthly average, for total suspended solids was established relating to effluent limitations for wastewater treatment facilities in the Chickahominy watershed in eastern Virginia. Total suspended solids in Indian Creek were above 5.0 mg/l at 8 sites in September 2001, and ranged from 7 mg/l at site 6 to 95 mg/l at site 22. Total suspended solids were above 5.0 mg/l at 5 sites in May 2002, and ranged from 8 mg/l at sites 12 and 22 to 240 mg/l at site 14.

Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Dissolved heavy metals (such as arsenic, cadmium, iron, lead, and mercury) can be toxic to plants and animals in elevated concentrations. The more common dissolved solids (including sodium, potassium, sulfates, chloride, nitrate and fluoride) can have both beneficial and detrimental environmental effects. Other than U.S. Environmental Protection Agency (EPA) secondary standards for drinking water (500 mg/l), there are no biological water quality standards for total dissolved solids. Total dissolved solids in September 2001 were analyzed with the Hydrolab and through the analytical laboratory in Georgia. Results with the Hydrolab showed dissolved solids ranging from 55 mg/l at site 14 to 322 mg/l at site 3. Laboratory results complemented those of the Hydrolab, with results ranging from 45 mg/l at site 14 to 320 at site 3. In May 2002, results for dissolved solids were not recorded with the Hydrolab. Laboratory results showed dissolved solids ranging from 60 mg/l at site 15 to 280 mg/l at site 3.

Conductivity is a measure of the ability of water to carry an electrical current. Conductivity is related to the amount of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate ions or sodium, magnesium, calcium, iron, and aluminum cations. Electrical conductivity estimates the amount of total dissolved solids, or the total amount of dissolved ions in the water. Generally, rivers with conductivity ranging between 150 and 500 microohms per centimeter (µhos/cm) support a good diversity of fish and other aquatic organisms. Conductivity outside of this range may compromise the ability of the system to support some species of fish or invertebrates (USEPA 1997). Three of the sites (site 2, site 3 and site 4) lie within limestone valleys and have naturally high conductivity due to the limestone influence. As predicted, these sites had the highest conductivity during both rounds of sampling, with ranges from 393 (Site 4) to 503 µhos/cm (Site 3) in September 2001 to 381 (Site 4) to 484 µhos/cm (Site 3) in May 2002. Conductivity was lowest at Site 14 (86 µhos/cm) in September 2001 and Site 15 (64 µhos/cm) in May 2002.

Water hardness is also related to the dissolved solids in the water and was measured as the amount of calcium carbonate ($CaCO_3$)in a water sample. Calcium usually enters the water from either $CaCO_3$, as limestone or from mineral deposits of calcium sulfate ($CaSO_4$). The three sites in the limestone valley had hard water with hardness measured at 215, 255, and 270 mg/l at sites 4, 2, and 3, respectively. Low water hardness was found in the headwater sites in the North and South Branch, with values of 49, 50, and 57.5 mg/l at sites 15, 22, and 14, respectively.
Nitrogen is one of the most abundant elements on earth and comprises almost 80 percent of the earth's atmosphere as nitrogen gas. It is found in the cells of all living things and is a major component of proteins. Inorganic nitrogen may exist in the free state as a gas (N_2), or as nitrate (NO^{3-}), nitrite (NO^{2-}), or ammonia (NH^{3+}). Plants and animals usually need nitrogen in other chemical forms. In its various forms, nitrogen can deplete dissolved oxygen in receiving waters, stimulate aquatic plant growth, exhibit toxicity toward aquatic life, and present a public health hazard. Point and non-point source runoff may contain nutrients such as nitrogen and phosphorus and can cause eutrophication, the excessive growth of plant and/or algae blooms.

This study measured nitrogen as nitrate + nitrite, ammonia as nitrogen, and total Kjeldahl nitrogen.

In September 2001, detectable nitrogen concentrations, as measured by nitrate + nitrite, was detected at 21 sites, and ranged from a low of 0.06 mg/l at site 9 to a high of 0.82 mg/l at site 3. Nitrogen was below detection at site 15. In May 2002, nitrate + nitrite was detected at all sites, with levels ranging from 0.032B mg/l at site 14 to 0.76 mg/l at site 18. The "B" denotes that the reported value was less than the reporting limit but greater than or equal to the method detection limit.

Ammonia as nitrogen (mg/l) was only detected at five sites in September 2001, with concentrations ranging from 0.021B mg/l at site 19 to 0.11 mg/l at site 15. In May 2002, ammonia was detected at all sites, with concentrations ranging from 0.018B mg/l (site 7) to 0.16 mg/l (site 14). All detectable concentrations fell below acute and chronic Virginia water quality criteria for freshwater (VDEQ 2004). The acute ammonia criteria is dependent on pH and is based on a one-hour average concentration. At a pH of 7.8 in trout waters, the criteria is 8.11 mg/l. The chronic criteria is temperature and pH dependent, and the thirty-day average concentration of ammonia where early life stages of fish are present at a pH of 7.8 and temperature of 18EC, shall not exceed 2.54 mg/l, more than once every three years on the average.

Total Kjeldahl nitrogen (TKN) measures the organic and ammonia nitrogen forms. There are no numeric criteria for total Kjeldahl nitrogen in Virginia water quality standards. Total Kjeldahl nitrogen was detected at 10 locations during September 2001, ranging from 0.13B mg/l at site 7, to 1.0 mg/l at site 20, and 4 locations during May 2002, ranging from 0.13B mg/l at sites 2 and 3 to 0.87 mg/l at site 14.

Like nitrogen, phosphorus can take on many forms and is constantly changing. Unlike nitrogen, phosphorus is much more limited in the water under normal conditions. Phosphorus is one of the key elements necessary for growth of plants and animals. Total phosphorus is a measurement of all forms of phosphorous in a water sample. Too much phosphorus in the water can lead to excessive plant growth and potentially toxic conditions for aquatic life. There are no statewide numeric criteria for phosphorous in freshwater in Virginia water quality standards, however, a standard of 0.1 mg/l for total phosphorus was established relating to effluent limitations for wastewater treatment facilities in the Chickahominy (a freshwater) watershed in eastern Virginia. Phosphorus was detected at 16 sites in Indian Creek September 2001, at levels just above this standard at sites 17 (0.13 mg/l) and site 20 (0.14 mg/l). Phosphorus was detected at 14 sites in May 2002, at levels above this standard at site 17 (0.33 mg/l).

Total coliform bacteria are a collection of microorganisms that live in large numbers in the digestive tract of man and warm- and cold-blooded animals and aid in food digestion. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coli*. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. Fecal coliform bacteria may occur in water as a result of point sources such as municipal or industrial discharge and/or non-point sources such as agricultural animal waste, application of manure and biosolids to fields, failed waste-disposal systems, pet waste, landfill seepage, and wildlife waste (Wilhelm and Maluk, 1998).

Virginia water quality standards for fecal coliform bacteria are listed for shellfish waters (i.e., oysters and clams in the coastal zone) and "other waters." Relating to "other waters," the criteria is applied to protect primary contact recreational uses and is stated as:

> Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water.

Table 6 presents the results of the coliform analysis. The concentration of bacteria in a sample of water is expressed as the number of bacteria colonies per 100 milliliters (colonies/100 ml) of water. In September 2001, eight sites had fecal coliform counts greater than 100 colonies/100 ml of water, with site 2 having the greatest number at 7,600 colonies/100 ml of water. In May 2002, 12 sites had fecal coliform counts greater than 100 colonies/100 ml of water, with site 2 again having the greatest number at 6,500 colonies/100 ml of water. Calculating the geometric mean for both sampling events, seven sites (1, 2, 4, 6, 17, 20 and 21) had fecal coliform counts greater than 400 colonies/100 ml of water. None of the sites in the headwater streams had elevated fecal coliform counts.

Metals - surface water

Table 5 shows the results of surface water analysis for positive detections and qualified data. These data are bolded in the table. Data that is not bolded shows method detection limits for compounds that were analyzed for but not detected. Section 304(a)(1) of the Clean Water Act requires the Environmental Protection Agency to develop criteria for water quality for the protection of aquatic organisms and their uses. Acute and chronic values are established for most priority pollutants in both freshwater and saltwater habitats. The freshwater criterion maximum concentration (CMC), as established by the EPA, is an estimate of the highest concentration of a pollutant, to which an aquatic community can be exposed briefly (acute) without resulting in an unacceptable effect. The criterion continuous concentration (CCC) is an estimate of the highest concentration of a pollutant to which aquatic organisms can be exposed indefinitely without causing unacceptable effects (chronic toxicity). The data set for contaminants detected in surface water is evaluated against the CMC and CCC criteria for freshwater.

The only semivolatile compound detected in water samples collected in September 2001 was the common laboratory contaminant, bis(2-ethylhexyl)phthalate, and it was detected at sites 8, 9, and 10. Levels ranged from 0.70J to 0.91J µg/l; the "J" denoting that the presence of the compound in the water met the identification criteria for that compound, but the result is less than the project reporting limit and greater than the method detection limit. Neither this compound, nor any of the other semivolatile compounds, were detected in any of the water samples collected in May 2002.

Benzene was detected (detection limit 1.0 µg/l) at 2 of the 22 sites at low levels in September 2001, and was not detected at any sites in May 2002. Concentrations in September 2001 were 0.19J and 0.16J µg/l at sites 18 and 20, respectively. "J" denotes that the presence of the compound met the identification criteria, but the result is less than the project reporting limit and greater than the method detection limit. There are no CMC and CCC for benzene, although detected concentrations fall below the reported 5,300 µg/l lowest observable effect level (Buchman 1999).

Toluene was not detected (detection limit 1.0 µg/l) at any sites in May 2002, but was detected at site 7 in September 2001 at a concentration of 0.59J µg/l. There are no CMC and CCC for toluene, although the detected concentration falls below the reported 17,500 µg/l lowest observable effect level (Buchman 1999).

Total phenolics were detected (detection limit 50 µg/l) at 3 of the 22 sites at low levels in September 2001, and were not detected at any sites in May 2002. Concentrations in September 2001 were 0.14B, 0.12B, and 0.122B µg/l at sites 1, 17, and 19, respectively. There are no CMC and CCC for total phenolics, although detected concentrations all fall below CMC and CCC for individual phenol compounds.

Total cyanide was detected (detection limit 10 µg/l) at sites 9 and 10 (September 2001) at concentrations of 7.4B and 7.7B µg/l, respectively, and site 17 (May 2002) at a concentration of 8.5B µg/l. These concentrations fall below the CMC (22 µg/l) but are above the CCC (5.2 µg/l).

Chlorinated pesticides were not detected in any of the water samples in either September 2001 or May 2002. Detection limits ranged from 0.5 to 5 µg/l depending on the particular pesticide.

Polychlorinated biphenyls were not detected in any of the water samples collected in September 2001 or May 2002. Detection limits ranged from 1.0 to 2.0 µg/l depending on the particular aroclor.

Antimony (detection limit 20 µg/l), cadmium (detection limit 5.0 µg/l), selenium (detection limit 5.0 µg/l), silver (detection limit 10.0 µg/l), and mercury (detection limit 0.2 µg/l) were not detected in any water samples collected September 2001 or May 2002. Beryllium was not detected (detection limit 1.0 µg/l) in any water samples collected in September 2001, but was detected in water collected at site 14 (1.2 µg/l) in May 2002. A criteria has not been established for beryllium, but the lowest observable effect level has been reported as 5.3 µg/l (Buchman 1999), so that the level of beryllium detected at site 14 is not likely to cause any adverse effects to aquatic organisms.

Thallium was detected in water collected from site 21 (6.7B µg/l) in September 2001, but was not detected (detection limit 10 µg/l) in any water samples collected in May 2002. A criteria has not been established for thallium, but 1,400 and 40 µg/l have been proposed as the CMC and CCC, respectively (Buchman 1999). The level of thallium detected at site 21 falls below the proposed criteria.

Arsenic was only detected (detection limit 5.0 µg/l) in water collected in September 2001 at site 8 (3.5B µg/l) and in water collected in May 2002 at site 14 (6.5 µg/l). These levels fall below both the CMC and CCC, which is 340 and 150 µg/l, repectively for arsenic.

Chromium was detected (detection limit 3.0 µg/l) in water collected at eight sites in September 2001. Concentrations ranged from 0.75 µg/l at site 16 to 1.9B µg/l at site 17. In May 2002, chromium was only detected in water at site 14 at a concentration of 11 µg/l. All detectable concentrations are below CMC and CCC.

Copper was detected in water from 10 sites in September 2001, and of those, 9 were qualified "B." The concentration of copper in water from site 14 was 8.5 µg/l. Copper was detected in water collected at all sites in September 2001, and of those, 20 were qualified "B." The concentration of copper in water from sites 14 and 18 was 17.0 and 7.0 µg/l, respectively. The water quality criteria for copper is hardness dependent. With increasing hardness values, numeric water quality criteria increase. The water hardness at sites 14 and 18 is low: 43 mg/l (May 2002) and 72 mg/l (September 2001) at site 14 and 56 mg/l (May 2002) at site 18. Water quality criteria for copper is based on dissolved concentrations. Metal concentrations in Table 5 are reported as total recoverable. Dissolved copper concentrations were calculated by multiplying the total concentration by an EPA-established conversion factor (0.96) and then comparing to hardness-specific criteria. The hardness-specific CMC and CCC for copper at site 14 (September 2001) is 10.3 and 7.1 µg/l, respectively. Therefore, the calculated dissolved concentration of copper (8.2 µg/l) detected in water at site 14 only exceeds the CCC. The hardness-specific CMC and CCC for copper at site 14 (May 2002) is 6.3 and 4.5 µg/l, respectively. The calculated dissolved concentration of copper (16.3 µg/l) detected in water at site 14 exceeds the CMC and CCC. The hardness-specific CMC and CCC for copper at site 18 (May 2002) is 8.1 and 5.7 µg/l, respectively. The calculated dissolved concentration of copper (6.7 µg/l) detected in water at site 18 exceeds only the CCC.

Lead was detected (detection limit 10 µg/l) in water from sites 10 and 17 at concentrations of 2.6B and 3.6B in September 2001, and at site 14 at a concentration of 6.3B in May 2002. To calculate the dissolved lead concentration, the conversion factor for lead is hardness dependent. This leads to concentrations of lead at 2.1, 2.8, and 5.3 µg/l, respectively in water at sites 10, 17, and 14. The water quality criteria for lead is also hardness dependent. None of the dissolved concentrations exceed CMC, but the lead concentration in water from site 14 exceeds the hardness-specific CCC (2.1 µg/l).

Nickel was detected (detection limit 5.0 µg/l) in low concentrations at 8 sites in September 2001. Concentrations ranged from 1.4B to 3.9B µg/l and were all qualified "B." Nickel was only detected at site 14 in May 2002 at a concentration of 16 µg/l. The hardness specific CMC and CCC for nickel at site 14 is 355 and 39.5 µg/l, respectively and are above the detected value.

Zinc was detected (detection limit 10 µg/l) in the water samples collected September 2001 at 14 sites, and at 12 sites, values were "B" qualified. Zinc was detected at 14 and 70 µg/l at sites 17 and 14, respectively. Zinc was detected in water collected at all sites in May 2002, and 21 sites were "B" qualified. The highest detected concentration was at site 14 at 57 µg/l. Zinc criteria are also hardness-specific. None of the dissolved concentrations exceed hardness-specific CMC or CCC.

Metals - sediment

Table 7 only shows the results of sediment analysis for positive detections and qualified data. These data are bolded in the table. Data that is not bolded shows method detection limits for compounds that were analyzed for but not detected. The complete analytical data set is provided in the appendix.

Unlike promulgated water quality criteria, for most contaminants, there are no established criteria for sediments. The National Oceanic and Atmospheric Administration (NOAA) has compiled reference tables for use in evaluating inorganic and organic contaminants in various media (Buchman 1999). The threshold effects level (TEL) represent the concentration below which adverse effects are expected to occur only rarely. It is calculated as the geometric mean of the 15^{th} percentile concentration of the toxic effects in NOAA's data set and the median of the no-effect data set. The probable effects level (PEL) is calculated as the geometric mean of the 50^{th} percentile concentration, and is the level above which adverse effects are frequently expected. Freshwater sediment TELs and PELs are based on benthic community metrics and toxicity test results. The data set for contaminants detected in sediments is evaluated against TELs, PELs, and background levels, as initially reported in Buchman (1999).

Sediments collected in September 2001 from sites 2, 6, and 19 had positive detects for several of the semivolatile organic compounds (SVOC). Concentrations of SVOCs were generally low (below 1 mg/kg) at each of the sites. The sediment sample from site 21 had a single hit for di-n-butylphthalate, again at a low concentration (41 µg/kg). All SVOC concentrations were qualified with "J" denoting that the presence of the compound in the sediment met the identification criteria for that compound, but the result is less than the project reporting limit and greater than the method detection limit. SVOCs were again detected in low concentrations in the sediment samples collected in May 2002 from sites 2, 6, and 19, and most results were qualified with "J." The common laboratory contaminant, bis(2-ethylhexyl)phthalate, was detected at sites 3, 13, and 14. The levels of pyrene at site 2 (1000 µg/kg) and site 6 (500 µg/kg) were not qualified, and these levels exceed levels of concern. The TEL for pyrene is 53 and the PEL is 875 µg/kg.

One of the metabolites for DDT, 4,4'-DDD, was detected in the sediment sample collected in September 2001 at site 1. The concentration was relatively low (1.6 µg/kg). No other sediments had positive detections for DDT or its metabolites. No other chlorinated pesticides were detected at any of the sites. Neither DDT or its metabolites was detected at site 1 in May 2002; however, 4,4'-DDT was detected at sites 4 (3.8J µg/kg), 8 (0.79J µg/kg), 19 (1.4J µg/kg), and site 20 (0.74JP µg/kg) at low concentrations. There are no recommended TELs or PELs for this compound. Other chlorinated pesticides were detected at low concentrations, and were all qualified as “J” and “P.” As noted above, “J” denotes that the presence of the compound in the sediment met the identification criteria for that compound, but the result is less than the project reporting limit and greater than the method detection limit. “P” denotes that the relative percent difference in concentrations resulting from two dissimilar gas chromatograph columns was greater than 40 percent, even though both columns identified the compound, thus leading to questionable results. These chlorinated pesticides included alpha and delta BHC (hexachlorocyclohexane) at site 20 (0.98 and 0.25 µg/kg, respectively), alpha BHC at site 19 (0.38 µg/kg), heptachlor at sites 19 and 20 (0.33 and 0.45 µg/kg, respectively), and endrin aldehyde at site 18 (0.35 µg/kg). There are no recommended TELs or PELs for these compounds.

No polychlorinated biphenyls were detected in any of the sediment samples collected in September 2001 or May 2002. Detection limits (dl) ranged from 44 to 87 µg/kg in September 2001 and 41 to 420 µg/kg in May 2002.

Of the volatile organic compounds, methylene chloride was detected in sediments from five sites in September 2001. Methylene chloride was detected in the method blank sample analyzed with this group of sediments, therefore, it is likely that methylene chloride detected in site sediments is due to contamination in the laboratory. Methylene chloride was not detected in sediments in May 2002. Chlorobenzene was detected (3.8J µg/kg) in the sediment sample collected from site 17 in May 2002. No other volatile organic compounds were detected.

For the sediment samples collected in September 2001, total phenolics were below detection limits at all sites, with detection limits ranging from 1.4 to 2.7 mg/kg. Total phenolics were detected in sediments collected at 13 sites in May 2002. Concentrations ranged from 0.32B mg/kg at site 4 to 4.0 mg/kg at site 2. The concentration of total phenolics is the duplicate sediment sample collected at site 2 was 1.9B mg/kg. Total phenolics were not detected in any of the quality control samples, and it was not a batch specific phenomenon, so it does not appear that it is a laboratory contaminant. No apparent trends were discernible for the distribution of phenolics that were detected. There are no screening criteria for sediments to evaluate the levels of total phenolics that were detected.

Total cyanide was not detected in any of the sediment samples collected in September 2001 or May 2002. Detection limits ranged from 1.3 to 2.7 mg/kg in September 2001 and 1.2 to 3.1 mg/kg in May 2002.

Of the priority pollutant metals that were analyzed, selenium (1.1 to 2.8 mg/kg detection limits) and silver (1.1 to 2.8 mg/kg detection limits) were below detection limits at all sites in September 2001 and May 2002.

Results for antimony for both September 2001 and May 2002 are all qualified “N” because the spiked sample recovery was not within control limits. Results at 10 sites sampled in September 2001 were also qualified “B” since the reported value was less than the reporting limit but greater than or equal to the method detection limit. Results at these 10 sites ranged from 0.61 (site 21) to 1.3 mg/kg (site 22). Results at sites 9 and 19 sampled in May 2002 were qualified

“B,” with values of 0.64 and 1.0 mg/kg, respectively. All sites with positive detections are above the reported background concentration of antimony (0.16 mg/kg) but are below the suggested ecological screening criteria (3.0 mg/kg) (Buchman 1999).

Results for cadmium at all sites sampled in both September 2001 and May 2002 were also qualified with a “B.” Results for mercury at 17 sites sampled in September 2001 and 19 sites sampled in May 2002 were qualified with a “B.” Mercury levels at the other sites were below detection limits. Detectable concentrations of cadmium and mercury were all at or below reported background levels (Buckman 1999) for cadmium (0.1 to 0.3 mg/kg) mercury (0.4 to 0.5 mg/kg).

Arsenic was detected in sediments collected in September 2001 at all sites, and ranged from 2 (site 6) to 23 mg/kg (site 4). Arsenic levels at both of these sites are above reported background concentrations (1.1 mg/kg). Arsenic in sediments at site 4 is above both the TEL (5.9 mg /kg) and the PEL (17 mg/kg).   Arsenic was again detected in all sediments collected in May 2002. Arsenic concentrations ranged from 1.2 mg/kg at site 11 to 31 mg/kg at site 3. Arsenic concentrations in sediments at sites 2, 3, 4, 19, and 20 are above the TEL.

Beryllium was detected in sediment from all sites sampled in September 2001 at levels ranging from 0.35 (site 18) to 1.9 mg/kg (site 15). Beryllium was again detected in all sediments sampled in May 2002, with concentrations ranging from 0.26 mg/kg (site 16) to 2.9 mg/kg (site 3). Beryllium is widely distributed in the environment at low concentrations, with an overall average concentration of 2.8 to 5.0 mg/kg has been estimated (ATSDR, 1993). Levels in the Indian Creek watershed were at or below background. No screening criteria have been suggested for beryllium.

Chromium was detected in sediment from all sites in September 2001 at levels ranging from 3 mg/kg at site 6 to 76 mg/kg at site 4. Chromium was again detected in sediment from all sites in May 2002, although five of the sites were qualified with “N” denoting that the spiked sample recover was not within control limits. During this round of sampling, chromium concentrations ranged from a low of 2.4N mg/kg at site 16 to a high of 84 mg/kg at site 3. Chromium background concentrations range from 7 to 13 mg/kg. Sites 2, 3, 4 during both rounds of sampling exceed this level. Levels at site 3 and 4 are above the TEL (37.3 mg/kg), but below the PEL (90 mg/kg).

Copper was detected in sediment from all sites in September 2001 at levels ranging from 2.6 mg/kg at site 18 to 260 mg/kg at site 4. Most of the sites (17 of the 22) sampled in May 2002 had qualified results (N, E, *) for copper. As noted above “N” denotes that the spiked sample recovery was not within control limits. “E” denotes that the reported value is estimated because of the presence of interference during sample analysis, and “*” denotes that the duplicate analysis was not within control limits. The useable data for copper is limited to sites 9, 10, 17, 19, and 20. At these sites, copper concentrations ranged from 4.1 mg/kg at site 10 to 9.5 mg/kg at sites 17 and 20. Copper background concentrations range from 10 to 25 mg/kg. Levels of copper observed at site 4 during September 2001 are above the TEL (35.7 mg/kg) and the PEL (197 mg/kg).

Lead was detected in all sediments collected. In September 2001, concentrations ranged from 3.6B mg/kg at site 6 to 26 mg/kg at site 4, and in May 2002, concentrations ranged from 3.0BE mg/kg at site 16 to 50E mg/kg at site 3. Lead concentrations in September 2001 at site 4, and in May 2002 at sites 2, 3, 4, and 15, exceed reported background concentrations of 4 to 17 mg/kg. The lead concentration in sediments collected at site 3 during May 2002 exceeds the TEL (35 mg/kg), but not the PEL (90 mg/kg).

Nickel was detected in all sediments collected. In September 2001, concentrations ranged from 4.0B mg/kg at site 6 to 21 mg/kg at site 15. Nickel concentrations were above background (9.9 mg/kg) at 10 sites. The TEL (18 mg/kg) was exceeded at sites 3 and 15. The PEL (35.9 mg/kg) was not exceeded at any sites. In May 2002, concentrations ranged from 4.1B mg/kg at site 16 to 40 mg/kg at site 3. Eight sites had nickel concentrations above background. The TEL was exceeded at sites 2, 3, and 4 and the PEL was exceeded at site 3.

Thallium was detected at low concentrations in sediments collected in September 2001 at 12 of the 22 sites and ranged in concentration from 1.0B mg/kg at site 18 to 6.7B mg/kg at site 2. Thallium was only detected in sediments at site 15 (0.78B mg/kg) in May 2002. There are no sediment screening criteria for thallium.

Zinc was detected in sediment samples collected at all sites in September 200l, although results at 10 of the sites were qualified “E.” Of the other 12 sites, concentrations ranged from a low of 20 mg/kg at site 6 to a high of 88 mg/kg at site 2. Concentrations of zinc in sediment from sites 1, 2, 3, 4, 15, 21, and 22 were above background (7 to 38 mg/kg). No samples exceeded the TEL (123.1 mg/kg) or PEL (315 mg/kg). All samples collected in May 2002 were qualified as either “NE” or “E” and the data was not evaluated.

Acid volatile sulfides (AVS) are found in sediments and help to bind several divalent metals, such as lead, so that they are not bioavailable and not toxic (Di Toro et al. 1992). The AVS is extracted from sediment using hydrochloric acid. The metal concentration that is simultaneously extracted is termed the simultaneously extracted metal (SEM). Only five metals, cadmium, copper, lead, nickel, and zinc, are typically evaluated using SEM. The ratio of SEM to AVS is related to metal availability, with ratios greater than one predicting metal bioavailability, because there is not sufficient AVS to bind metals. AVS/SEM analyses were conducted and results are reported in Table 7. Overall, very little AVS was detected. Only 7 sediment samples collected in September 2001 had detectable AVS, and of these, only site 4 showed an appreciable level of AVS at 400 mg/kg. The other six sites had AVS concentrations that ranged from 18 to 96 mg/kg. The sites with detectable AVS were sites with drainage areas less than five square miles, with the exception of site 1. In May 2002, only two sites had detectable concentrations of AVS, sites 2 and 3, with 330 and 340 mg/kg, respectively. It is interesting to note that three of the seven sites with detectable AVS (in September 2001) and both sites with detectable AVS (in May 2002) are in the limestone ecoregion.

It is also interesting to compare these results with the grain size data (Table 8). Overall, most sediment samples had a high percentage of sands and gravel. When the percentages are summed, sand and gravel makes up more than 70 percent of the sediment sample in 19 of the 22 sites in September 2001 and 17 of the 22 sites in May 2002. AVS is mostly associated with anoxic, depositional areas, and sand and gravel areas do not allow for AVS. AVS was not detected in any of the sediment samples that had more than 70 percent sand and gravel.

With the exception of cadmium, the concentrations of the SEM metals were generally lower than the total metals (presented above). Total cadmium concentrations were already at low levels.

AVS/SEM is mostly used to help interpret toxicity data at sites with elevated metals. Toxicity tests were not a component of this study, but AVS/SEM is used to predict metal bioavailability and potential toxicity. As the results above indicate, metal concentrations were relatively low at most locations, and did not exceed screening criteria. AVS/SEM will only be discussed for those sites that exceeded screening criteria for either cadmium, copper, nickel, zinc, or lead. When the ratio of AVS to SEM is greater than one, AVS concentration in a sample is presumed sufficient to bind metals so that they are not bioavailable. For the samples collected in September 2001, none of the sites exceeded screening criteria for cadmium, zinc, or lead.

The copper concentration was elevated at site 4 in September 2001. The total molar concentration of SEM metals of the site 4 sediment is 0.000386 micromoles/gram (µmol/g). The molar concentration of AVS at site 4 is 0.00416 µmol/g, yielding a ratio of AVS:SEM of 16.38. Therefore, the AVS concentration at site 4 should be high enough to render copper less bioavailable. Copper concentrations in May 2002 were below screening values.

Nickel concentrations were elevated at sites 2 and 15 in September 2001. The total molar concentration of SEM metals of the site 2 sediment is 0.00111 µmol/g. The molar concentration of AVS at site 2 is 0.000999 µmol/g, yielding a ratio of AVS to SEM of 0.90. Therefore, the AVS concentration at site 2 may not be high enough to render nickel less bioavailable. The total molar concentration of SEM metals of the site 15 sediment is 0.000386 µmol/g. The molar concentration of AVS at site 2 is 0.000141 µmol/g, and was calculated using half of the detection limit (27 mg/kg). The ratio of AVS to SEM is 0.365.

Nickel concentrations were also elevated at sites 2, 3, and 4 in May 2002. The total molar concentration of SEM metals of the site 2 sediment is 0.000940 µmol/g. The molar concentration of AVS at site 2 is 0.00344 µmol/g, yielding a ratio of AVS to SEM of 3.66. Because the level of AVS in the sediment collected in May 2002 was much higher than the sediment collected in September 2001, the AVS/SEM ratio was greater than one. The total molar concentration of SEM metals of the site 3 sediment is 0.00109 µmol/g. The molar concentration of AVS at site 3 is 0.00354 µmol/g, yielding a ratio of AVS to SEM of 3.25. The total molar concentration of SEM metals of the site 4 sediment is 0.000980 µmol/g. The molar concentration of AVS at site 4 is 0.000083 µmol/g (using one half the detection limit), yielding a ratio of AVS to SEM of 0.085. So even though the nickel concentration is lowest at site 5, it poses the greatest risk because of the absence of sufficient AVS.

SURVEY OF THE PERIPHYTON COMMUNITY

INTRODUCTION

Periphyton are defined as the assemblage of microorganisms that grow on the surface of submerged substrata in almost all aquatic ecosystems (Nelson et al. 1973). Because benthic algal assemblages are attached to substrate, their characteristics are affected by physical, chemical, and biological changes that occur in the stream reach during the time in which the assemblage developed. Periphyton are composed mostly of plant material and is mainly algal in nature (Hynes, 1972). They form the base of aquatic food webs, and are consumed by small invertebrates and fish.

Periphyton growth is controlled by temperature, sunlight, time between flooding, substrate stability, water flow, nutrients (primarily nitrogen and phosphorus) and grazing by invertebrates (Kalff and Knoechel 1978). Healthy streams typically have little obvious periphyton, because growth is limited by invertebrate grazers and converted into invertebrate biomass. Excessive nutrients from point and non-point sources can lead to algal blooms. Such blooms alter the natural chemistry of aquatic systems through changes in photosynthesis/respiration activities, which result in high pH and widely varying dissolved oxygen levels. The phytoplankton community provides an early-warning indicator of changes in water quality and can be used in assessments of point and non-point source impacts. Responses in periphyton community include changes in biomass or species composition (Baffico 2001).

This investigation focused on the algal periphyton in order to provide baseline characterization data. Periphytic algae (especially diatoms) are considered good indicators of the ecological condition because they: 1) are fairly simple to collect, 2) respond rapidly and predictably to changes in stream chemistry and habitat quality, 3) are taxonomically diverse, 4) have short regeneration times, and 5) are ubiquitous allowing for comparisons across geographic regions (Hill et al. 2001). In most studies of the periphyton community, the oldest and most widely used approach is to provide a submersed substrate for colonization for a specific period of time. The organisms that colonize the substrate are identified and counted, and estimates of biomass are made (Wetzel 1965).

METHODS

Field Methods

Pennington and Associates, Inc. was contracted to conduct a survey of the periphyton communities at 22 locations in the Indian Creek Watershed, Tazewell County, Virginia. The locations of each sampling site coincide with those of the analytical sampling sites. The appendix has a table that shows the latitude and longitude of each location. In addition to collection of periphyton samples, stream width, depth, velocity, substrate, pH, conductivity, dissolved oxygen, and temperature were measured at each location.

Artificial substrates consisting of multiple 2-inch square textured tiles attached to bricks were placed at each of the 22 site locations in the Indian Creek watershed. The tiles were placed on April 25, 2001 and were to be retrieved in six weeks. Heavy rains and flooding in the watershed delayed collecting the substrates until mid July. Substrates were retrieved from 17 of the 22 sites. The tiles were not found at sites 6, 7, 14, 17 and 20. At the five sites where the tiles were lost, rock scrapings were taken. The periphyton samples were placed in plastic containers, tagged and placed on dry ice. The samples were divided in the field with one portion shipped to TAI Environmental Services in Mobile, Alabama for chlorophyll and ash free dry weight analyses. The remaining portion was returned to Pennington and Associates, Inc. central laboratory for determination of species present, enumeration of individuals for each species and number per unit area (density), determination of biovolume (cell volume) and calculation of metrics of biotic integrity. Cell densities are calculated by dividing the numbers of cells by the proportion of sample counted and the area from which samples were collected. Cell biovolumes are determined by summing the products of cell density and biovolume of each species counted and dividing that sum by the proportion of sample counted and the area from which samples were collected.

Laboratory Analyses

Chlorophyll and ash free dry weight analyses were accomplished using techniques described in Section 10 200I (biomass), pages 10-26 and 10-27, and Section 10300C, pages 10-34 and 10-35 in Standard Methods for the Examination of Water and Wastewater, 20th Edition (Clesceri et al. 1998). Chlorophyll *a* ranges from 0.5 to 2% of total algal biomass (APHA 1995), and this ratio varies with taxonomy, light, and nutrients. Ash-free dry mass is a measurement of the organic matter in samples, and includes biomass of bacteria, fungi, small fauna, and detritus in samples. Identifications and counts of the periphyton species were made using the inverted microscope method as described in section 10300C.2 of Standard Methods (Clesceri et al. 1998). Additional analyses of the diatom species were made by making permanent slide mounts of cleared diatoms. The diatoms were cleared using the oxidation technique as described in Barbor et al. (1999) and Standard Methods Section 10300C.3 (Clesceri et al. 1998).

Data analyses for each location included the following metrics as excerpted from Barbour et al. 1999):

- **Species Richness.** An estimate of the number of algal species in a sample. High species richness is assumed to indicate high biotic integrity because many species are adapted to the conditions present in the habitat. Species richness is predicted to decrease with increasing pollution because many species are stressed. However, many habitats may be naturally stressed by low nutrients, low light, or other factors. Slight increases in nutrient enrichment can increase species richness in headwater and naturally unproductive, nutrient-poor streams (Bahls et al. 1992).

- **Total Number of Genera.** Generic richness should be highest in reference sites and lowest in impacted sites where sensitive genera become stressed. Total number of genera may provide a more robust measure of diversity than species richness, because numerous closely related species are within some genera and may artificially inflate richness estimates.

- **Total Number of Divisions** represented by all taxa should be highest in sites with good water quality and high biotic integrity.

- **Shannon Diversity (for diatoms).** The Shannon Index is a function of both the number of species in a sample and the distribution of individuals among those species (Klemm et al. 1990). Low diversities represent conditions where only a few organisms are abundant, to the exclusion of other taxa.

- **Percent Community Similarity (PS_c) of Diatoms.** The percent community similarity index, discussed by Whittaker (1952), was used by Whittaker and Fairbanks (1958) to compare planktonic copepod communities. It was chosen for use in algal bioassessment because it shows community similarities based on relative abundances, and in doing so, gives more weight to dominant taxa than rare ones. Percent similarity can be used to compare control and test sites, or average community of a group of control or reference sites with a test site. Percent community similarity values range from 0 (no similarity) to 100 percent. The formula for calculating percent community similarity is:

  $$PS_c = 100 - .5\sum_{i=1}^{s}|a_i - b_i| = \sum_{i=1}^{s}\min(a_i, b_i)$$

  Where:
  a_i = percentage of species i in sample A
  b_i = percentage of species i in sample B

- **Pollution Tolerance Index for Diatoms.** The pollution tolerance index (PTI) for algae resembles the Hilsenhoff biotic index for macroinvertebrates (Hilsenhoff 1987). Lange-Bertalot (1979) distinguishes three categories of diatoms according to their tolerance to increased pollution, with species assigned a value of 1 for most tolerant taxa (e.g., *Nitzschia palea* or *Gomphonema parvulum*) to 3 for relatively sensitive species. Lange-Bertalot's PTI varies from 1 for most polluted to 3 for least polluted waters when using the following equation:

  $$PTI = \frac{\sum n_i t_i}{N}$$

  Where:
  - n_i = number of cells counted for species i
  - t_i = tolerance value of species i
  - N = total number of cells counted

  In some cases, the range of values for tolerances has been increased, thereby producing a corresponding increase in the range of pollution tolerance index values.

The **Jaccards Coefficient of Similarity was also measured.** The Jaccards coefficient of similarity (CC_J) compares the presence-absence of species between two communities. The index shows the abundance of individuals in the calculation. CC_J represents the similarities among taxa between different sites. The equation is written as:

$$CC_j = \frac{C}{S_1 + S_2 - C}$$

where S_1 = number of taxa in community 1, S_2 = number of taxa in community 2, and C = number of taxa common to both communities. The lower the value of CC_J, the more similarities exist between taxa common to the two sites.

Cluster analyses were conducted on the Jaccard's Coefficient and Percent Similarity data. Cluster analysis sorts sampling units into groups based on the overall resemblance to each other (Ludwig and Reynolds 1988). By using the percent dissimilarity, sampling units are sorted to permit grouping. The cluster analysis combines the distances between sampling units into a matrix table, and two strategies of clustering are used to calculate a distance for N-1 cycles (N=number of sampling units). The cluster analysis is interpreted graphically on a dendrogram to relate the similar communities (Eckblad 1989, Ludwig and Reynolds 1988).

RESULTS AND DISCUSSION

Physical and chemical data of all 22 locations are presented in Table 9. Temperature ranged from 17EC to 24.7EC. Dissolved oxygen levels were just under saturation at all locations except sites 14 and 22 where dissolved oxygen levels were reduced. pH levels were near neutral to slightly alkaline at all locations.

A list of periphytic algae species including tolerance values and the number of cells per mm^2 are found in Table 10. A graphic presentation of the number of species per site is presented in Figure 2 while the numbers of cells per mm^2 are shown in Figure 3. The same information, including calculated cell biovolume (mm^3/mm^2), is provided in the appendix. Comparisons of the sites using species shared are presented in Figure 4 (all species) and Figure 5 (diatoms only). Similar comparisons using species shared with a density component are found in Figure 6 (all species) and Figure 7 (diatoms only). Table 11 contains the chlorophyll and biomass data for each site.

There was a minimum of 41 periphytic algae species collected from all locations. In general, diatoms dominated the algal assemblage with 29 diatom species (Bacillariophyceae), followed by 10 green (Chlorophyta) and 2 bluegreen algae (Cyanophyta) species. The greatest number of species was collected at site 1 with 26, followed by 22 at site 3, and 15 at both sites 6 and 15. The lowest number was found at site 16 (Table 2, Figure 1) with only 5 species. Sites 19 and 10 had only diatom taxon.

In terms of number of cells per mm^2 (Table 10, Figure 3), site 18 had the highest density with 420.84 cells/mm^2. Site 18 also had the highest biovolume estimate (1705.1 mm^3/mm^2) and second highest chlorophyll (49.41 mg/m^2) concentration (Table 3). Site 15 (326.1/mm^2), site 6

(314.5/mm^2), site 21 (284.7/mm^2), site 1 (268/mm^2) and site 7 (260.0/mm^2) were the next highest sites in terms of density. Site 5 had the lowest density with 0.364/mm^2.

Chlorophyll was highest at site 3 (68.09 mg/l) followed by site 5 (52.2 mg/l), site 18 (49.4 mg/l), site 12 (33.4 mg/L) and site 15 (30.5 mg/l) and lowest at site 19 (0.19 mg/l) (Table 11). Biovolume estimates were greatest at site 18 (1705.1 mm^3/mm2), site 7 (1693.060mm^3/mm^2), site 1 (1383.0 mm^3/mm^2), and site 15 (1308.9 mm^3/mm^2) (Table 3). Biovolume was lowest at sites 10 (0.13 mm^3/mm^2), 16 (0.38 mm^3/mm^2), and 19 (0.71 mm^3/mm^2).

Shannon diversity (H') values were highest at sites 1, 12, 3, 5, 7, 6 and 2. The lowest diversity values were measured at sites 11 and 18 because of the abundance of *Achnanthes lanceolata* in the community (Table 10).

The pollution tolerance index (PTI) calculated from the diatom populations at each location ranged from 2.44 at site 6 to 3.00 at sites 9, 16, and 19 (Table 10). Most of the PTI values were near 3.00, indicating relatively unpolluted waters at most locations.

Comparison of the sites using species shared for all algae species (Figure 3) produced two distinct clusters and five less distinct groupings. Sites 3, 7, 6, and 1 form a distinct cluster with sites 10, 22 and 16. The remaining sites formed the second cluster. A comparison using only diatom species also has two distinct clusters (Figure 4). Sites 1, 3, 6, and 7 form one cluster with all other sites forming the second grouping.

When a density component was considered using all algae species (Percent Similarity), two major clusters were observed (Figure 5). Sites 1, 6, and 7 formed a secondary grouping with sites 11, 13, 21, 15, 22 and 18, which together formed a major cluster. The remaining sites formed the second major cluster. Comparisons of only diatom species using Percent Similarity (Figure 6) produced similar clusters as found with all algae species.

An Assessment of the Macroinvertebrate Communities

INTRODUCTION

The Rapid Bioassessment Protocol (RBP) was originally developed by Plafkin *et al*. (1989) and has been amended by Barbour *et al*. (1999) to establish guidance for evaluating impacts of chemical, physical, and/or biological stressors on an aquatic ecosystem by evaluating the macroinvertebrate community. Any of these stressors may result in impaired functioning or loss of a species with a subsequent change in the benthic community structure. The surrounding habitat is equally important in determining the success of the resident community. Both the quality and quantity of available habitat can affect the structure and composition of aquatic communities. In significantly altered streams (i.e., channelized or heavily urbanized streams) such as some of those evaluated in this study, suitable reference sites may not be available (Gibson *et al*. 1996).

In February 2002, the Environmental Protection Agency's Region III Freshwater Biology Team, with staff from the FWS Virginia Field Office, collected benthic macroinvertebrate samples, measured physical/chemical parameters, and performed visual qualitative physical habitat surveys using the EPA's Rapid Bioassessment Protocol. The objective of the benthic macroinvertebrate survey wais to provide data on the condition of the tributaries of Indian Creek and selected sites on the mainstem of Indian Creek. Benthic macroinvertebrate sampling locations were in the general location of sites used for chemical analysis (map 1). The appendix includes a table of the benthic macroinvertebrate sampling locations, including latitudes and longitudes of each site.

METHODS

Monitoring parameters, methods and their frequency of collection

Benthic macroinvertebrate samples, physical/chemical field parameters and visual qualitative stream habitat evaluations were collected once at each site during the week of February 26, 2002. The benthic macroinvertebrate samples were collected using the USEPA RBP single habitat protocol, with slight modifications. Four 0.25 m^2 sections of stream riffle were sampled using a 0.5 meter wide, 600 um mesh rectangular dip net. These four samples were composited for a total of one m^2 sampled. In the laboratory, a standard proportion (1/8th) of the sample was subsampled and analyzed to the family level. For calculation of taxa richness measures, the resulting data were rarefied to a 200 organism fixed count subsample. Rarefaction is a statistical procedure that allows a direct comparison of the number of taxa found in samples when the sampling or subsampling effort differed. Rarefaction uses the data from the original sample to answer the question, "how many taxa would have been found in a smaller sample?" Rarefaction takes hypothetical subsamples of a fixed number of organisms from the original sample, and calculates the richness metrics for each hypothetical subsample (Krebs 1998). For this study, the rarefaction procedure took 200 hypothetical subsamples of 200 organisms from the original sample, and calculated average total taxa richness and EPT (Ephemeroptera, Plecoptera, Trichoptera) richness metric values for those 200 subsamples for each site. These average richness metrics were used in scoring the metric for the VSCI calculation.

The stream habitat evaluations were conducted using the EPA RBP riffle/run protocol for high gradient streams. The field chemical/physical parameters (dissolved oxygen, temperature, conductivity, and pH) were measured using a Corning Checkmate 90 field meter, which was calibrated according to the manufacturer's instructions every day. The range of velocities in the sampled reach were measured using a Marsh McBirney velocity meter.

The Virginia Stream Condition Index

For this study, the Virginia Stream Condition Index (VSCI) and its component metrics were used to assess the macroinvertebrate assemblage data. The VSCI was developed by Tetra Tech Inc., using the Virginia Department of Environmental Quality (VDEQ) macroinvertebrate database (Burton and Gerritsen 2002). The VSCI is a family-level index.

Eight metrics make up the VSCI:

> **Total Taxa** reflects the health of the community through a measurement of the variety of taxa present and generally increases with increasing water quality, habitat diversity, and habitat suitability.
>
> The **EPT Taxa** measures the total number of distinct taxa within the orders Ephemeroptera, Plecoptera, Trichoptera (or mayflies, caddisflies, stoneflies). EPT taxa generally increases with improving water quality.
>
> The **% EPT** metric is based on the proportion of individuals in the sample that belong to the Ephemeroptera order.
>
> **% Plecoptera plus Trichoptera less Hydropsychidae** (%P + T - H) measures the percent of Plecoptera and Trichoptera not including pollution tolerant caddisflies in the family Hydropsychidae
>
> The **% Chironomidae** metric is based on the proportion of individuals in the sample that belong to the family Chironomidae. This metric generally increases with degrading stream condition.
>
> **% Scrapers** is based on the number of taxa in a sample that graze on substrate (i.e., periphyton-attached algae and associated material).
>
> The **Hilsenhoff Biotic Index** (HBI) is an abundance-weighted average tolerance of assemblage of organisms (family taxonomic level).
>
> The **% 2 Dominant Families** (% 2 Dom Fam) metric is based on the proportion of individuals in the sample that belong to the two most dominant taxa. In healthy streams, there are generally several families with the individuals evenly distributed among the different families.

These metrics were chosen in a rigorous process so that: 1) the metrics could discriminate clearly between a priori most-disturbed (impaired) and least-disturbed (reference) sites; 2) the metrics represent several different aspects of the biotic community (e.g. composition, richness, diversity, tolerance, trophic groups); and 3) the metrics chosen minimize redundancy among component metrics.

The eight metrics were aggregated into an index by calculating the 5th percentile (% Chironomidae, % 2 Dom Taxa, HBI) or the 95th percentile (Total Taxa, EPT Taxa, % E, %P + T - H, % Scrapers) for all 1,671 non-coastal plain samples in the VDEQ 1994-2002 database. These values were considered the standard "best" values. These values were then assigned a score of 100. Values of a metric between the minimum possible value (or in some cases the maximum possible value) and the standard best score were then scored proportionally from 0 ("worst") to 100 ("best"). The standard best values developed using the VDEQ dataset are similar to those developed for West Virginia using a similar process, but using WV DEP's database (Gerritsen et al. 2000).

By standardizing the metric values to a common 100-point scale, each of the metrics contributes to the combined index with equal weighting, and all of the metric scores represent increasingly "better" site conditions as scores increase toward 100. Once all metric values for sites were converted to scores on the 100-point scale, a single multi-metric index value was calculated by averaging the individual metric scores for the site. See Table 12 for a list of the metrics, the standard (best values) and the standardization equations.

Richness metrics for macroinvertebrates have been shown to be positively correlated with abundance (Gerritsen et al 2000). VDEQ's sampling methods vary slightly across the state, but their subsample organism counts usually vary from 100 to 200 organisms. This study used a standard proportion (1/8th) of the total sample as a subsample. This procedure standardizes the subsample by proportion, so the number of organisms in the subsample can vary quite widely depending on the productivity of the sampled streams. More productive streams will have much higher counts in the subsample than less productive streams. In this study, for samples with greater than 200 organisms, the proportion subsample data was rarefied to 200 organisms and richness measures were calculated on the fixed count subsample in order to score samples using the VSCI richness best standard values. Seventeen (17) of the 24 subsamples were rarefied. The remaining seven proportional subsamples had between 100 and 200 organisms.

The descriptive statistics and distribution of VSCI scores of the a priori reference site samples were used to establish a threshold for determining whether test sites are comparable to the reference condition (Table 13). In the final VSCI report, the 10^{th} percentile was recommended as a threshold to determine impairment (Burton and Gerritsen 2003). The 10^{th} percentile VSCI score of the reference site samples was 61.3. The VSCI scores were used to determine impairment and to rank the sites. Sites are noted where the genus-level taxa lists indicate a change in condition, but the family-level VSCI does not fully reflect those assemblage changes.

MACROINVERTEBRATE RESULTS

The macroinvertebrate component metrics and VSCI scores for the sites are shown in Table 14. Note that for three sites, there are duplicate samples. These duplicate samples are used to estimate sampling method precision. Data generated from the first sample collected that day was displayed on map 2 (VSCI scores), map 3 (total taxa), and map 4 (EPT taxa). The taxonomic lists are shown in Table 15. All total taxa and EPT (Ephemeroptera - mayflies, Plecoptera - stoneflies and Trichoptera - caddisflies) taxa values discussed are at the family level for the rarefied 200 fixed count subsamples. Many of these values, since they are averages, are not integers.

Figures 8, 9, and 10 indicate the VSCI scores, the total taxa values and the EPT taxa values for the 200 fixed count subsamples. The mainstem, tributary and limestone sites are grouped in separate bar graphs. The sites are listed from upstream to downstream order on each graph.

Most of the sites are located in the Cumberland Mountain area of the Central Appalachians (see Map 2). Some of the sites are located in the Southern Limestone/Dolomite Valleys and Rolling Hills of the Ridge and Valley Ecoregion. It should be noted that the VSCI study indicated that historical VDEQ reference sites in the Central Appalachians had lower VSCI scores as a group than reference sites located in other non-coastal ecoregions of Virginia. The interquartile range of VSCI scores for the Central Appalachians ecoregions was approximately 55 to 70. The interquartile range of all noncoastal reference sites was approximately 68 to 78. It is not clear whether a separate (lower) threshold of impairment is needed for the Central Appalachians, or if the historical database in the Central Appalachians was biased to more impaired sites, and more sampling needs to be done to identify candidate reference sites in this region.

Many of the sites (12 of 21) in this study exceeded the state-wide noncoastal VSCI impairment threshold of 61.3. Three (3) sites scored less than the state-wide threshold but still within the interquartile range of the Central Appalachians reference sites (less than 61.3 but greater than 55). Six (6) sites had VSCI scores lower than the interquartile range of the Central Appalachians reference sites (less than 55). These six sites were site 1 (Indian Creek behind the trailer park), site 2 (Lowe Branch), site 4 (unnamed tributary that drains McGuire Valley), site 15 (South Branch of Indian Creek), site 19 (Coal Branch), and site 21 (Indian Creek at Cedar Bluff).

Mainstem Indian Creek Sites

There were eight RBP sampling sites on the mainstem of Indian Creek. Starting at the upstream end, site 13 (upstream of Jackson Fork) was sampled in duplicate. The first sample scored 72.5 using the VSCI. The second sample had a VSCI score of 70.1. The taxa lists for both samples indicate good richness and evenness. There were 24.7 and 22.0 total taxa and 17.5 and 15.0 EPT taxa in the two samples. The site had a large number of EPT taxa, and many sensitive taxa (e.g. *Dolophilodes, Glossosoma, Rhyacophila, Neophylax, Diploperla, Acroneuria, Paracapnia, Pteronarcys, Ephemera, Epeorus, etc.).* The dominant taxon was midge, but midge only accounted for about 23% of the total organisms in both samples. The taxa lists for the two sites were very similar. Site 13 is clearly in good condition.

Site 16, located downstream of Jackson Fork, had a VSCI score of 61.8. The VSCI score dropped from that found at site 13 due to an increase in the number of Chironomidae collected at site 16. Chironomidae accounted for 45% of the organisms in the sample collected at this site. However, the number of total taxa (20.5) and the number of EPT taxa (13.4) were still high at site 16. A good number of more sensitive taxa were collected (*Dolophilodes, Neophylax, Goera, Acroneuria, Diploperla, Strophopteryx, Paracapnia, Epeorus, Ephemera, etc.)*. The taxa list suggests site 16 is in good condition, although the VSCI score is slightly less than the state-wide threshold recommended for determining impairment.

Site 11, in Harmon, had a VSCI score of 72.2. This site was also sampled in duplicate and the second sample scored 67.1. Although the VSCI score indicates site 11 is in good condition overall, the taxa lists from both samples indicate loss of some more sensitive taxa. Taxa richness values were lower in both samples (15 and 19) and EPT taxa values were lower in both samples (9 and 10) than what was collected at upstream sites. The taxa losses are particularly noticeable in the genus-level data. When the data are collapsed to family, the differences between sites are smaller. The numbers of EPT organisms also decreased from upstream sites. Based on the loss of sensitive taxa, the lower taxa richness and EPT taxa values, there appears to be a change in condition at site 11 in Harmon.

Site 8, upstream of Panther Branch, looks similar to site 11. The VSCI score at this site was 69.7. However, this site also had fewer total taxa (17) and EPT taxa (9) than the sites upstream of Harmon. The abundance of these organisms dropped as well. Many of the more sensitive taxa found upstream of Harmon were not found in the sample collected at site 8.

Site 18, downstream of the railroad trestle in Bandy, had a VSCI score of 58.9. More sensitive taxa were again collected at this site, but the sample was dominated by blackflies and midge. This shift in composition to a predominance of more tolerant organisms drove the VSCI score lower. Midge made up 22.2% of the sample at this site. There were 18.1 total taxa and 8.4 EPT taxa in the sample. Some of the more sensitive taxa collected upstream of Harmon were also collected at site 18 (*Glossosoma, Goera)*. The abundance of EPT organisms also increased.

Site 5, upstream of the railroad trestle on Rt. 630, had a VSCI score of 79. This site had good total taxa richness (23.1) and evenness, and had a good number of EPT taxa (13). The dominant taxon at this site was midge, although they were not overly abundant (only 24.7%).

Site 1, behind the trailer park, had a VSCI score of 43.3. This site has lower total taxa richness than the nearest upstream site (16) , and the taxa list indicates a loss of EPT taxa (7). The relative abundance of sensitive taxa decreased at this site. The sample was dominated by midge (56.4% of the sample). Overall abundance of other organisms at this site was low.

Site 21, at Cedar Bluff, had a VSCI score of 47.7. The VSCI score was driven down by an abundance of midge in the sample (53.6%). However, the sample still contained a good number of total taxa (17.8) and a fair number of EPT taxa (8.1), with some more sensitive taxa collected (*Brachycentrus, Helicopsyche, Allocapnia, Serratella)*. The abundance of all organisms at site 21 was much higher than the abundance at site 1.

In summary, the samples collected at three sites on the mainstem (sites 11 and 8 downstream of Harmon, and site 1, in the trailer park) indicate some degradation compared to other sites in the watershed. At all of these sites, there was a loss of some of the more sensitive taxa and low overall abundance. Site 21 shows an overabundance of midge, but still has good taxa richness. The VSCI does not appear to be very sensitive to the loss of rare taxa. Rare is defined as more sensitive taxa that are not found in large numbers. The VSCI is a family level index and some of the taxa losses that are present at the genus level are not present when the data are collapsed to family. The rest of the mainstem sites appear in good condition, although midge or blackflies were abundant or dominant at some of the sites (sites 16, 18 and 21), as indicated by the lower VSCI scores.

Tributary Sites

There were ten tributary sites including the North and South Branches of Indian Creek. Most of the tributary sites are located in the Cumberland Mountains region (subecoregion 69d). The North and South Branches of Indian Creek both had considerable beaver activity and many instream beaver ponds. These ponds made it difficult to find good sampling habitat. Site 15, on the South Branch, was located in a short reach between a beaver pond and a culvert upstream and an impounded area downstream, at the confluence with the North Branch. The bad weather and poor road conditions made it impossible to look further upstream for a more suitable site. The VSCI score at site 15 was only 40, but this score is not likely representative of the true condition of the South Branch. Total taxa (16) and EPT taxa were not collected in abundance at this site (8). The habitat was clearly degraded instream, with some embeddedness and sediment deposition. Midge was the dominant taxon collected at this site (59.4%).

Site 23, on the North Branch of Indian Creek, was added to the site list since two of the original sites in the project plan (sites 14 and 22) could not be sampled due to beaver pond activity and lack of access due to bad road conditions. Site 23 was added and was located between sites 14 and 22. A good number of total taxa (21.9) and EPT taxa (13.4) were collected at this site. Midge dominated the sample (45.3%), and the VSCI score was 58.4.

Site 12 was located on Jackson Fork, which enters Indian Creek from the northeast of the watershed. Although the topographic map indicates substantial historical mining in this tributary's watershed, several total taxa (22.9) and EPT taxa (14.5) were collected, including some of the more sensitive taxa (*Glossosoma, Dolophilodes, Diplectrona, Rhyacophila, Paracapnia, Acroneuria, Pteronarcys, Epeorus, Baetisca, Ephemera, etc.*). In addition, the sample portrayed an even composition, with midge accounting for only 12.6% of the sample. The VSCI score was 71.8.

Greasy Creek is the next tributary downstream and enters Indian Creek from the west. Site 9 is located upstream on Consol Coal Company property. Although the habitat at this site was degraded, several EPT taxa (12) were collected, including several of the more sensitive taxa (*Hydatophylax, Neophylax, Pycnopsyche, Clioperla, Baetisca, Ephemera, Ameletus, etc.*). Although organisms were not collected in great number, the sample was well balanced, and midge only accounted for 24.6% of the sample. The VSCI score was 72.3.

The downstream site on Greasy Creek (site 10) was also in good condition. The habitat was much better at this site, and a few more EPT taxa were collected (13.6). The sample was also well balanced and midge accounted for only 19.6% of the sample. The VSCI score was 78.9.

Panther Branch is the next tributary downstream, and also enters Indian Creek from the west. Site 17 was located right next to the road, and the habitat was not optimal, but the sample collected from Panther Branch indicates a good variety of total taxa (21.4) and EPT taxa (12.3), with a fairly balanced assemblage. Although midge were the dominant taxon, they were not present in extreme numbers and made up only 25.2 % of the sample. The VSCI score for site 17 was 71.9.

Site 19 was located on Coal Branch, upstream of the railroad trestle. The VSCI score was 49, reflecting the large number of midge and tolerant Hydropsychidae caddisflies in the sample. Midge accounted for 34% of the sample. There were fewer total taxa (15.8) and EPT taxa (5.8) in the sample and they were collected in low numbers. Only one Plecoptera individual was in the sample.

Two sites were located on Laurel Fork. Site 6, the downstream site, had some habitat degradation due to the road and mowed lawns, but a good number of total taxa (18.1) and EPT taxa (11.2) were collected, including several more sensitive taxa (*Neophylax, Goera, Clioperla, Baetisca, Ephemera, Epeorus, etc.*). A tolerant caddisfly (*Cheumatopsyche)* dominated the sample. Midge accounted for only 16.5% of the sample. The VSCI score at this site was 67.9.

The upstream site on Laurel Fork was located upstream of the Rt. 626 bridge. Site 7 was sampled in duplicate and the two samples had VSCI scores of 73.4 and 69.7. Both samples indicate a good number of total taxa (20 and 20.9) and EPT taxa (13 and 12.8). Midge were the dominant taxon in both samples (23.8 and 30.3%), but the taxa lists indicate that overall, the community was fairly well balanced among all the major insect groups.

The most downstream tributary was Raven's Nest Branch (site 20). This tributary also enters from the west, and was sampled upstream of the railroad tunnel, in a pasture. Although the habitat was not optimal in the sampled reach, total taxa (19.8) and EPT taxa (12) were found in good numbers. The community was well balanced among the major insect groups, and midge accounted for only 10.4% of the sample. The dominant taxon was the stonefly *Amphinemura*. The VSCI score was 82.9. This site had the highest VSCI score in the study.

In summary, the South and North Branch samples may not be representative of the true condition of these tributaries. As noted above, finding areas to sample was difficult and in both cases suboptimal or even marginal habitats were selected for sampling. These tributaries may be in better condition than data indicate. The nearest downstream station on the mainstem, which receives the major part of its flow from these two tributaries, was in very good condition. Coal Branch may have some impairment, since it is lacking many of the sensitive taxa found in the other tributaries. The habitat at the Coal Branch sampling site was also suboptimal and may have contributed to the lower VSCI result.

Limestone Sites

The Indian Creek watershed is a geologically diverse watershed. Three of the sites (site 2, site 3 and site 4) lie within limestone valleys (subecoregion 67f after Woods et al.1999). These sites are different from the other sites due to the limestone influence and their naturally high conductivity. Site 3, the upstream site on Lowe Branch, represents a typical limestone stream. The taxa list indicates high abundance with fair taxa richness (14.5) and a fair number of EPT taxa (7.2). There were good numbers of organisms in the more sensitive EPT orders. The dominant taxon at this site was an *Ephemerella* mayfly. The VSCI score for this site was 61.

Site 2, the downstream site on Lowe Branch, had a VSCI score of only 25.7. The taxa list for this site indicates a loss of sensitive taxa, including the loss of all stoneflies and a sharp reduction in mayflies. The sample contained only 9.3 total taxa and 1.7 EPT taxa. The taxa list also indicates increases in tolerant taxa including a caddisfly (Hydropsychidae) and midge (Chironomidae). The dominant taxon was midge, which accounted for 66.3 % of the organisms.

Site 4 is located on an unnamed tributary that drains McGuire Valley. This site scored 46.1 using the VSCI. Site 4 had a good number of total taxa (16.8) and a fair number of EPT taxa (7.3), but very few stoneflies and reduced numbers of mayflies compared to site 3. The site was dominated by tolerant midge and blackflies.

QUALITATIVE HABITAT AND FIELD CHEMISTRY RESULTS

Physical and chemical characteristics of the sampled sites including mean stream width, mean velocity, temperature, conductivity, dissolved oxygen and pH are shown in Table 16. None of the field physical and chemical results indicate water quality problems, although, sampling for this study was in February 2002. Parameters such as pH, temperature, and dissolved oxygen typically reach critical levels in the summer and early fall when temperatures are elevated and primary productivity and respiration are at their peaks.

The Rapid Bioassessment Protocol component habitat parameters and total habitat scores are shown in Table 17. The Rapid Bioassessment Protocol has specific criteria and descriptions for each parameter in ranges of optimal, suboptimal, marginal, and poor. In general, optimal conditions provide high quality habitat and have the potential to sustain diverse natural assemblages of aquatic life. Marginal conditions provide habitat that is less than desirable and in poor conditions, the physical habitat is inadequate or absent. Optimal and suboptimal habitat are both considered sufficient to support macroinvertebrate assemblages. For example, state and federal agencies often require reference sites that are used to develop biological reference conditions to atain at least suboptimal scores. In Table 17, individual parameters that scored less than Suboptimal (<11) are bolded. The bolded parameters are in the marginal or poor range.

The habitat results indicate a few habitat impairments at some of the sites. In terms of overall score, only two sites show habitat problems in several components of instream, bank and riparian habitat. Site 9 (the upstream site on Greasy Creek) only scored a total of 107, and scored only marginally in epifaunal substrate/available cover, embeddedness, sediment deposition, frequency of riffles and riparian zone width. Despite these low habitat scores, the benthos sample for Greasy Creek indicates good water quality.

Site 15, the South Branch of Indian Creek scored only 96 on the visual habitat assessment. This site scored marginally on embeddedness, velocity depth regimes and sediment deposition. This site scored in the poor range for riparian zone width. As stated earlier, the sampling area was confined to a very short reach between a beaver pond and a culvert at site 15. The marginal instream habitat at this site may have impacted the benthos sample, which indicates some impairment.

Several of the sites scored less than suboptimal on the velocity depth regimes parameter. This is common for small streams, which often lack deep water, defined as greater than 0.5 meters. This does not impact the benthic samples since riffles were targeted in this study. Several of the sites scored less than suboptimal on the bank vegetation and riparian zone width scores. These two parameters reflect habitat condition outside of the immediate stream channel, and do not appear to impact the benthos samples as much as the instream parameters (epifaunal substrate, embeddedness, sediment deposition).

Figure 11 shows a scatter plot of VSCI scores and total habitat scores. Figure 12 shows a scatter plot of VSCI scores and conductivity. Neither graph indicates a strong correlation between the VSCI scores and physical or chemical parameters.

FISH SURVEYS

INTRODUCTION

Fish are one of the most widely used and useful group of organisms for evaluating water quality. They are typically present even in the smallest streams and are easily collected and identified with the proper equipment and training. Fish are a diverse group of organisms and have a wide range of life history requirements. Some fish are sensitive to changes in water temperature, substrate composition, stream flow, or water chemistry parameters, while others are tolerant of moderate changes in their environment. They occur throughout the aquatic food web at all trophic levels (i.e., herbivores, omnivores, piscivores). The structural and functional variety of fish communities make them good indicators of water quality.

The Clinch River drainage of southwestern Virginia contains the greatest number of fish species in the Commonwealth (Pinder and Jones 2000). The Indian Creek watershed is in the headwaters of the upper Clinch River. Masnik (1974) developed the initial fish species list, and sampling efforts by Jenkins and Burkhead (1994), Angermeier and Smogor (1993), and Pinder and Jones (2000) followed. Early collections in the Indian Creek watershed documented 35 fish species, and based on this fish community, rated the quality of its waters as “good” (Pinder and Jones 2000).

The Index of Biotic Integrity (IBI) for fish communities was first developed in the early 1980s for fish communities of moderate size in Midwest streams (Karr 1981). IBI is an index of fish community integrity that is composed of twelve different metrics (Table 18), or components of the fish community, ranging from individual-level characteristics (e.g., incidence of tumors or lesions) to community-level characteristics (i.e, number of sunfish or darter species, or specific feeding guilds). Potential scores for each metric are 1 (poor), 3 (intermediate), or 5 (ideal) and are assigned according to expectations for stream size and physiographic ecoregion. Scores for the 12 metrics are summed to yield an IBI value for each site, which is used to discriminate between very poor, poor, fair, good, or excellent fish communities. IBI methods have subsequently been modified for use throughout the country in all types of aquatic habitats (Simon and Lyons 1995).

METHODS

Field sampling followed the protocols described for determining the Index of Biotic Integrity (Karr, et. al. 1986) using fish communities, and later modified by the Tennessee Valley Authority for use in the Tennessee River drainage. Because scoring criteria for metrics vary among ecoregions, criteria specifically developed for the Ridge and Valley ecoregion of the Clinch/Powell watershed should be directly comparable to Indian Creek. Metric scores within the Indian Creek watershed are also scaled according to the drainage area of each sampling location, as more fish species are expected to occur in larger drainage areas.

Fish were collected using a gasoline-powered backpack electroshocker, dip nets, and seines at all sampling locations. The main procedure was shocking downstream into a seine stretched perpendicular to the streamflow, at an approximate distance of 20 feet. Fish stunned by the shocker drifted with the stream into the waiting seine, 20 feet in length, or were netted by a person accompanying the person with the shocker. In pools or other areas where streamflow was reduced, such as backwaters, fish were collected by hauling the seine through the slow or still water. Shorelines and associated cover (tree roots, undercut banks, tree trunks, vegetation, boulders) were sampled using the shocker and a person wielding a dip net. A unit of effort, then, was a shocking run, a seine haul, or five minutes of shoreline shocking, and represented an area of approximately 300 sq. ft. Effort was made to sample all available habitats within the sampling area, with respect to substrate, current, depth, and cover.

At each sampling location, samples were taken in each discernible habitat until three consecutive efforts produced no additional fish species for that particular habitat. Although, at times, crew leader discretion was used to adjust sampling effort.

At the end of each sampling effort, fish were identified to species, counted, and inspected for abnormalities (injuries, parasites, deformities, etc.). Resulting counts and observations were recorded on field forms. Presence of young-of-the-year fish (i.e., those in their first year of life) was noted on the field forms, although their occurrence and abundance was not used in bioassessment calculations. Young-of-the-year fish are omitted from the analysis because they have not been subjected to conditions at the sample site for an adequate period of time to fully reflect those conditions (Karr 1981). They are, however, noted in the comments section of the field sheet because they may provide additional insight on the health of the sample site (i.e., whether fish are reproducing). While most fish were released back into the stream, individuals of selected species were preserved in formaldehyde for laboratory verification of field identifications. Identifications of preserved fish specimens were carefully verified in the laboratory with the aid of two reference guides: *Freshwater Fishes of Virginia*, by Jenkins and Burkhead (1994), and *The Fishes of Tennessee*, by Etnier and Starnes (1993).

When calculating IBI scores for sites with drainage areas less than five square miles, alternative metrics were used to account for the naturally low fish diversity found in small, high-elevation, headwater streams. These substituted metrics include "number of riffle species," "number of pool species," "percent individuals of two dominant species," and "number of headwater intolerant species." These changes were applied to more than half of the Indian Creek sampling locations, including sites 2, 3, 4, 6, 7, 9, 10, 12, 14, 15, 17, 19, 20, and 22. All metrics score as 1-poor, 3-intermediate, or 5-high. Individual metric scores were totaled to produce an overall IBI value for each site. The following integrity classes were used to evaluate fish community integrity: 60-58 (excellent), 52-48 (good), 44-40 (fair), 34-28 (poor), and 22-12 (very poor).

Of prime importance to IBI analysis is the designation of fish species as tolerant or intolerant and their trophic status. Intolerant fishes are those species that cannot survive or reproduce in streams that are significantly altered physically, chemically, or biologically. Similarly, certain trophic groups are less able to survive in degraded stream conditions. The list of species encountered in these surveys and their designations of priority group (i.e., suckers, sunfish, and darters), sensitivity, and trophic status, and pool/riffle habitats are presented in Table 19.

RESULTS AND DISCUSSION

Summary results for the fish sampling event are presented in Table 20 and the complete data set is in the appendix. A total of 6,505 individual fish were found, representing 36 species.

Blacknose dace (*Rhinichthys atratulus*) was the species in greatest abundance with 1,503 individuals, followed by central stoneroller (*Campostoma anomalum*) with 1,340. Blacknose dace was found at all 21 sites, whereas central stoneroller was found at 15 of the 21 sampling sites. These two species represent 43 percent of the total species found. Site 1 had the most species with a total of 28 species, followed by sites 5 and 18, each with a total of 22 species.

One notable fish species was found during the survey. A dace, (*Phoxinus sp., cf. saylori*), found at sites 9, 14, 15, and 22, was initially thought to be the laurel dace (*Phoxinus saylori*). Dr. Chris Skelton, Georgia College and State University, is doing genetics testing for determination. If it is not the laurel dace, it is a new undescribed species. This 'species' was first collected in Virginia in 1998 in Mudlick Creek, Tazewell County, and then in two other creeks in Russell County (Skelton, pers. comm). It is not known whether these Virginia populations are previously unreported native populations or recent introductions (Strange and Skelton 2003). The laurel dace was previously thought to be limited to 5-6 streams in eastern Tennessee. The Virginia sites in which the species was collected is about 200 air miles separated from the nearest Tennessee laurel dace, making it unlikely a bait bucket introduction. The form in Virginia exhibits breeding color characteristics that distinguish it from the populations occurring in Tennessee (Skelton, pers. obs.) and is referred to herein as *Phoxinus sp. cf. saylori*. A photograph of the species is included at the end of the appendices.

To evaluate individual metric scores, sites were divided between those that had drainage areas less than five square miles, and those that were greater than five square miles (sites 1, 5, 8, 11, 13, 16, and 18). Metrics that consistently indicated favorable conditions at sites in the latter category were overall fish abundance, lack of hybridized individuals, low percentages of tolerant individuals, high percentages of intolerant individuals, and low frequency of tumors or other anomalies. All seven sites scored optimally for low percentages of tolerant individuals and lack of hybridized individuals. Six of the seven sites scored optimally for the number of native species and the percent of individuals with tumors and other anomalies. There were low numbers of suckers and piscivores at most of the sites, with site 1 being the only site with an optimum score for the number of suckers and site 16 the only site with an optimum score for the number of piscivores.

Overall, in sites with drainage areas less than five square miles, metrics consistently indicating favorable conditions had low percentages of tolerant individuals and the high percentages of lithophilic spawners. Lithophilic spawners are those species which lay their eggs directly on the substrate and practice no parental care. They require clean gravel or cobble for spawning and are especially sensitive to sedimentation and siltation of these substrates Site 6 was the only site with an optimal score for the percentage of riffle species and the percentage of intolerant species.

IBI values ranged from a low of 34 at site 3, indicating poor fish community integrity, to a high of 52 at site 16, indicating good fish community integrity. Five of the 22 sites were classified either poor or poor/fair. These sites had drainage areas less than five square miles, though there were a few other sites that scored fair to good with drainage areas less than five square miles.

Site 3 had the lowest IBI score (34) and scored low on 5 of the 12 metrics. There were no observations of riffle species, headwater intolerant species, specialized insectivores, omnivores or stoneroller species. One hundred twenty three individuals, representing four species, were observed. This site also scored low on the number of pool species, with only two species found (creek chub and rock bass), and the percent of individuals of two dominant species. As reported in the previous chapter, the Virginia Stream Condition Index (VSCI) score, used to assess the macroinvertebrate assemblage data, did not show impairment at site 3 (VSCI score 61), but was just at the state-wide threshold of 61.3. It was noted in the habitat assessment that channel alteration was a concern at this site, which probably had negative influence on the fish community.

Site 2 had the next lowest IBI score (36). There were no observations of riffle, headwater intolerant, or specialized insectivore species and only two species (creek chub and rock bass) of pool species at site 2. A total of 92 individuals, representing 4 species, was observed. At site 15, a total of 77 individuals, representing 5 species, including the suspected *Phoxinus sp., cf. saylori* were found. There were no observations of piscivore species and only one species of riffle and headwater intolerant species (fantail darter and the undetermined dace, respectively). Sites 2 and 15 had the two lowest VSCI scores (25.7 and 40, respectively). Site 2 scored low on the benthic macroinvertebrates due to a loss of sensitive taxa and an increase in the number of tolerant taxa. Site two also scored low on the habitat parameter “bank vegetative protection,” which evaluates the amount of stream bank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes. Vegetative cover increases stream bank stabilization and reduces the likelihood of erosion. Site 15 also showed signs of habitat degradation with some embeddedness and sediment deposition, but it was unclear whether this was truly representative of the site or a result of beaver impoundments in the area.

Sites 12, 15, and 17 had IBI scores of 38 (poor/fair). Overall, 183 individuals were observed representing 5 species, at site 12. This site scored low on the number of riffle and pool species, with only one riffle species (fantail darter) and two pool species (rosyside dace and creek chub). This site also scored low because of the absence of headwater intolerant species and piscivore species. The VSCI score for site 12 was good at 71.8. The mainstem Indian Creek (site 12) where Jackson Creek intersects is impaired due to channelization and sediment deposition, which could affect the number of fish using this area. Site 17 scored low on the number of riffle, headwater intolerant, specialized insectivore, and piscivore species. Site 17 is adjacent to a road providing sub-optimal habitat, however, the VSCI score was good (71.9).

Pinder and Jones (2000) conducted a comprehensive fish survey in the Indian Creek watershed to determine the distribution and composition of fishes, and to develop a baseline reference of stream health before construction of a mining facility in the headwaters of Indian Creek. Although this study tried to select sites in close proximity to those of Pinder and Jones, Pinder and Jones’ sites were largely chosen after the confluence of a tributary with the mainstem of Indian Creek. This study’s sites were primarily selected in tributaries, prior to confluence, in order to evaluate water quality within a defined reach by limiting the potential point and non-point sources of contaminant influence, and impacts of particular tributaries to the mainstem. Therefore, our IBI scores are not directly comparable to those of Pinder and Jones (2000).

Most species collected in September 2001 were the same as those reported by others in earlier sampling efforts. However, species not observed in this study, or in Pinder and Jones (2000) include gizzard shad (*Dorosoma cepedianum*) and golden redhorse (*Moxostoma erythrurum*). These species were collected by Angermeier and Smogor (1993). Mountain brook lamprey (*Ichthyomyzon greeleyi*) was observed by Masnik (1974) and in this study at site 8. Clinch sculpin (*Cottus sp.*) and largemouth bass (*Micropterus salmoides*) were reported by Jenkins and Burkhead (1994). In this study, Clinch sculpin was observed at sites 1, 4, and 5 and largemouth bass at sites 1 and 19. This study did not find any bluegill (*Lepomis macrochirus*), spotfin shiner (*Cyprinella spiloptera*), or banded sculpin (*Cottus carolinae*), although those species had been previously reported.

Pinder and Jones (2000) first reported blotchside logperch (*Percina burtoni*), wounded darter (*Etheostoma vulneratum*), and rosyside dace (*Clinostomus funduloides*) in Indian Creek. Rosyside dace was observed in this study at sites 7, 9, 10, 12, 13, 14, 19, and 22. This study also found the fathead minnow, (*Pimephales promelas*) (site 4), northern studfish (*Fundulus catenatus*) (site 1), and yellow bullhead (*Ameiurus natalis*) site 22, species that do not appear to have been reported previously. The mirror shiner (*Notropis spectrunculus*) is a rare species that has special concern status in Virginia (Pinder and Jones 2000). It was found at sites 5, 6, 8, 11, 16, 18, and 19.

Three non-native species rainbow trout (*Onchoryncus mykiss*) (site 1), redbreast sunfish (*Lepomis auritus*) (sites 1, 3, 8, 11, and 16), and brown trout (*Salmo trutta*) (site 7), previously reported, were also observed in this study. The fathead minnow (site 4) noted above is also an introduced species.

RECOMMENDATIONS

The headwaters and mainstem Indian Creek watershed were selected for study because of the rich biotic resources, including the only known reproducing population of the tan riffleshell mussel occupying the lower reaches of the sampling area. Many of the biological and water quality monitoring needs identified during the 1994 upper Tennessee River basin aquatic studies and GIS workshop were evaluated in Indian Creek. These biological information needs included: 1) monitor water quality in all streams in UTRB; 2) conduct fish and benthic macroinvertebrate Index of Biotic Integrity (IBI) studies for use in stream assessments; 3) assay for pesticides/herbicides in streams adjacent to agricultural land; and 4) assay for contaminants in streams adjacent to mined lands. Results of the integrated biological monitoring program for Indian Creek found that healthy biological communities, excellent habitat and water quality were present at many of the sampling stations. Sites 5, 7, 8, 9, 10, 11, 16, 18, and 22 harbor a large number of fish and benthic macroinvertebrate species. This fact together with low intensity land use indicates high potential for watershed protection efforts.

One of the most exciting finds of this study was the undescribed dace found at two of the healthy sites (9 and 22) and at sites 14 and 15. More extensive sampling in these reaches is warranted to determine the range of this species. Genetics studies need to be completed to identify it as the laurel dace or a new species. Regardless, this is a rare species that appears to have a restricted home range. The need for special protective measures for this species should be determined.

Results where patterns of impairment were evident point to areas of concern at several sites and future monitoring may be warranted. Lowe Branch (sites 2 and 3), and the unnamed tributary that feeds into it (site 4), had high fecal coliform counts and elevated metals in the sediments; sites 2 and 3 had low IBI scores; and site 2 had a low VSCI score. Agricultural and septic failures threaten water quality in these areas. The lower reaches of this study (sites 1, 20 and 21), near more developed areas, also showed high fecal counts. Sites 1 and 21 also had low VSCI scores.

The fecal coliform test is not specific for any one coliform type as it relates to coliform bacteria in the intestinal tract of warm blooded animals. At the sites with high fecal coliform counts, it may be beneficial to conduct additional tests to determine the source of the bacteria in order to determine the most effective means of remediation. Human neutral sterols, a class of compounds that include cholesterol and its metabolites, can be used to differentiate between coliform types. As a management action, results of this study can be used to provide a basis to secure funding to work with local authorities, who are already aware of problems in the area, to improve septic performance in localized areas.

It is also recommended as a management action that efforts be undertaken to work with landowners to minimize cattle access to Lowe Branch and its unnamed tributary. Grazing cattle in riparian areas changes vegetative cover, plant species composition, and reduces biomass. This leads to destabilization of stream banks, increased sediment erosion and sedimentation rates and increased nutrient runoff.

Water quality at site 14 should be monitored as samples showed elevated metals, although, at levels below water quality criteria. Mining activities in this area are the suspected source of the metals. IBI and VSCI scores were good at site 14. Although coal fines were not observed in the sediments at site 14, or any of the other locations sampled for this study, other scientists working in Indian Creek more recently report observations of increased coal fines in several areas. Grain size analysis at sites where coal fines have been observed should be repeated to determine whether the percentage of fine grains has increased, and whether a source of the coal fines can be determined. As a management action, the FWS should continue working with the coal operators in this area, the Division of Mined Land Reclamation, and the Virginia Coal Association to protect water quality in this stream reach of Indian Creek.

The Indian Creek watershed contains a wealth of natural resources, and results of this study provide a snapshot in time of the diversity of biota and water quality. Because small headwater streams, such as those evaluated in this study, influence the character and quality of downstream waters, protecting headwaters is critical to sustaining the biological productivity of downstream rivers. Proactive efforts to protect the rare aquatic resources and improve the water quality in the Indian Creek watershed should continue and should involve natural resource agencies, municipalities, academia, industry and regional stakeholders.

REFERENCES

Adams, W. J., R. A. Kimerle, and J. W. Barnett, Jr. 1992. Sediment quality and aquatic life assessments. *Environ. Sci. Techno*l. 26(10):1865–1875.

Agency for Toxic Substances and Disease Registry. 1993. Toxicological profile for beryllium. Update. Atlanta, GA, US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR/TP-92/08; NTIS Accession No. PB93-182434).

American Public Health Association (APHA). 1995. Standard methods for the examination of water and wastewater. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 19th edition, Washington, D.C.

Angermeier, P.L and R.A. Smogor. 1993. Assessment of biological integrity as a tool in the recovery of rare aquatic species. Final Report. Virginia Department of Game and Inland Fisheries, Richmond, Virginia. 31 pp.

Baffico, G.D. 2001. Variations in the periphytic community structure and dynamics of Lake Hahuel Huapi (Patagonia, Argentina), *Hydrobiologia*, 455:79-85.

Bahls, L.R., R. Burkantis, and S. Tralles. 1992. Benchmark biology of Montana reference streams. Department of Health and Environmental Science, Water Quality Bureau, Helena, Montana.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadable rivers: periphyton, benthic macroinvertebrates and fish, Second Edition. EPA 841-B-99-002. U. S. Environmental Protection Agency; Office of Water; Washington, D.C.

Buchman, M.F. 1999. NOAA screening quick reference tables. NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pp.

Burton, J. and J. Gerritsen. 2003. A Stream Condition Index for Virginia Non-Coastal Streams. Tetra Tech Inc., Owings Mills, Maryland.

Clesceri, L. S., A.E.K.Greenberg, A.D. Eaton and M. A.H. Franson. 1998. Standard methods for the examination of water and waste water, 20th edition. American Public Health Association, Washington, D. C.

Di Toro, D.M., J.D. Mahony, D.J. Hansen, K.J. Scott, A.R. Carlson, and G.T. Ankley. 1992. Acid volatile sulfide predicts the acute toxicity of cadmium and nickel in sediments. *Environ. Sci.Techno*l. 26:96–101.

Eckblad, J. 1989. A computer program for ecological analysis - Volume 3. Oakleaf Systems, Decorah, Iowa.

Etnier, D.A. and W.C. Starnes. 1993. The fishes of Tennessee. University of Tennessee Press, Knoxville, Tennessee. 681 pp.

Flanagan, P.J. 1990. Parameters of water quality. Interpretation and standards. 2nd Edition. Environmental Research Unit, Ireland.

Gerritsen, J., J. Burton, and M.T. Barber. 2000. A Stream Condition Index for West Virginia Wadeable Streams. Tetra Tech Inc., Owings Mills, Maryland.

Hill, B.H., R.J. Stevenson, Y. Pan, A.T. Herlihy, P.K. Kaufmann, and C.B. Johnson. 2001. Comparison of correlations between environmental characteristics and stream diatom assemblages characterized at genus and species levels. *J. N. Am. Benthol. Soc*., 20(2):299-310.

Hynes, H.B.N. 1972. The ecology of running water. University of Toronto Press. 555 pp.

Jenkins, R.E. and N.M. Burkhead. 1994. The freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland. 1,080 pp.

Karr, J.R. 1981. Assessment of biotic integrity using fish communities. *Fisheries* 66:21-27.

Karr, J.R., K.D. Fausch, P.L Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Special Publication 5. *Illinois Natural History Survey*. 28 pp.

Klemm, D.S., P.A. Lewis, F. Fulk, and J.M. Lazorchak. 1990. Macroinvertebrate field and laboratory methods for evaluating the biological integrity of surface waters. EPA/600/4-90/030. U. S. Environmental Protection Agency; Environmental Monitoring Systems Laboratory, Cincinnati, Ohio.

Krebs, Charles J. 1998. Ecological Methodology 2nd ed. Addison-Wesley Educational Publishers, Inc. Menlo Park, CA.

Lange-Bertalot, H. 1979. Pollution tolerance of diatoms as a criterion for water quality estimation. *Nova Hedwigia* 64:285-304.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods computing. John Wiley and Sons, New York. 337 pp.

Masnik, M.T. 1974. Composition, longitudinal distribution, and zoogeography of the fish fauna of the upper Clinch system in Tennessee and Virginia. Ph.D. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 401 pp.

Nelson, R.R., T.O. Odlaug, B.O. Krogstad, O.R. Rushnmeyer, T.A. Olson and W.G. Parkos. 1973. The effects of enrichment of Lake Superior periphyton. WRRC Bulletin 59, Minneapolis, Minnesota. 181 pp.

Pinder, M.J. and J.W. Jones. 2000. Species composition and biotic condition of the fish community of Indian Creek, Tazewell County, Virginia. *Banisteria* 16:3-14.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C. EPA 440-4-89-001.

Simon, T.P. and J. Lyons. 1995. Application of the index of biotic integrity to evaluate water resource integrity in freshwater ecosystems. Pages 245-262 *In* W.S. Davis and T.P Simon eds. Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL. 245-262.

Strange, R.M. and C.E. Skelton. 2003. Taxonomic status and distribution of blackside dace (*Phoxinus cumberlandensis*) and Clinch dace (*Phoxinus sp.* cf. *saylori*) in Virginia. Final Report, January 16, 2003. 17 pp.

U.S. Environmental Protection Agency. 2002. Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; National Primary Drinking Water Regulations; and National Secondary Drinking Water Regulations; Methods Update; Final Rule 40 CFR Parts 136, 141, and 143, October 23, 2002.

Virginia Department of Environmental Quality. 2004. State Water Control Board, 9 VAC 25-260 Virginia Water Quality Standards, Statutory Authority: § 62.1-44.15 3a of the Code of Virginia.

Wetzel, R.G. 1965. Techniques and problems of primary productivity measurements in higher aquatic plants and periphyton. Pages 249-267 *In* Proceedings of the I.B.P. Symposium on Primary Productivity in Aquatic Environments, Pallanza, Italy.

Whittaker, R.H. 1952. A study of summer foliage insect communities in the Great Smoky Mountains. *Ecological Monographs* 22:6.

Whittaker, R.H. and C.W. Fairbanks. 1958. A study of plankton copepod communities in the Columbia basin, Southeastern Washington. *Ecology* 39:46-65.

Wilhelm, L.J. and T.L. Maluk. 1998. Fecal-indicator bacteria in surface waters of the Santee River Basin and coastal drainages, North and South Carolina, 1995-98: U.S. Geological Survey Fact Sheet FS-085-98, 6 pp.

Woods, A., J. M. Omernik, D. D. Brown. 1999. Level III and IV Ecoregions of Delaware, Maryland, Pennsylvania, Virginia and West Virginia. USEPA. Corvallis, Oregon.

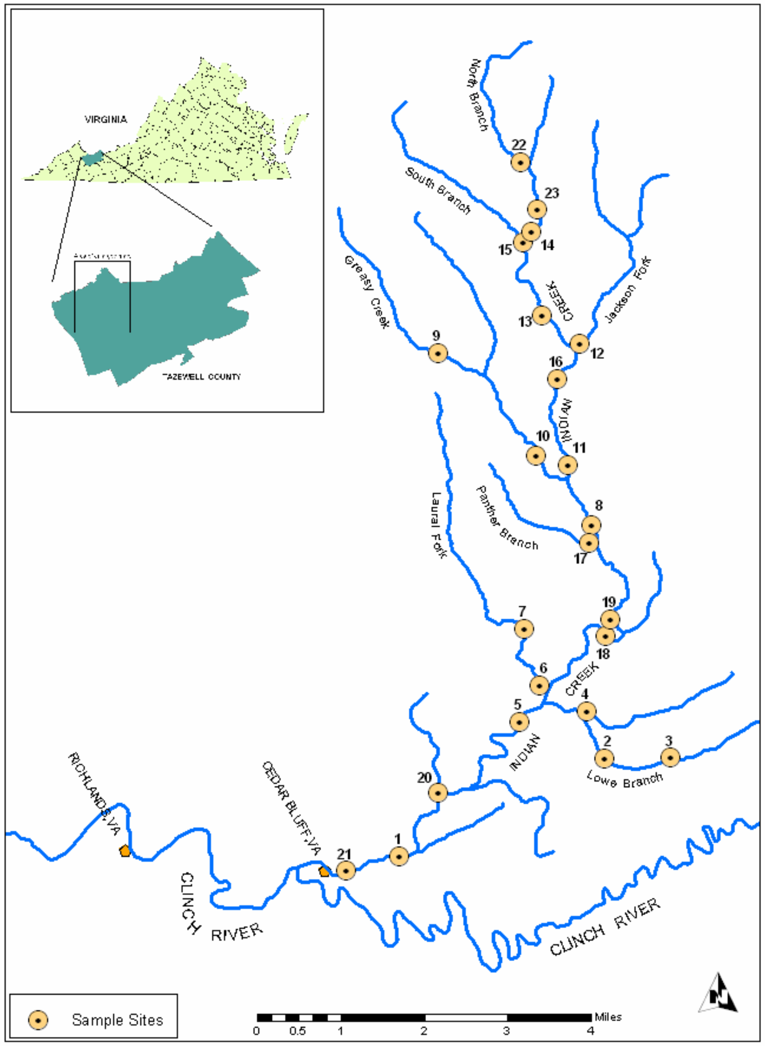


Figure 1. Indian Creek watershed, Tazewell County, Virginia, showing sampling stations for the chemical analysis, and periphyton, fish and benthic surveys.

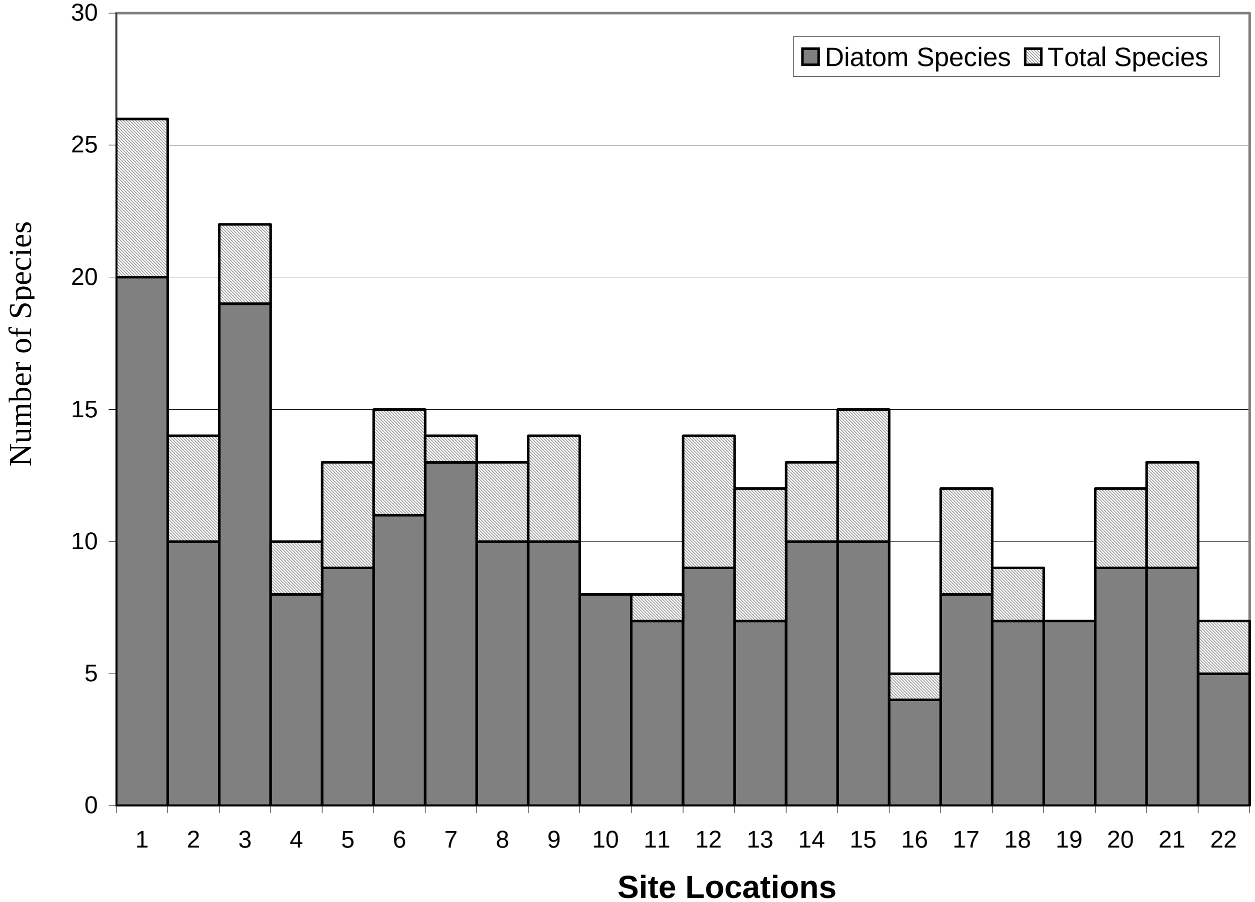


Figure 2. Number of periphyton species at each location, Indian Creek watershed, Tazewell County, Virginia.

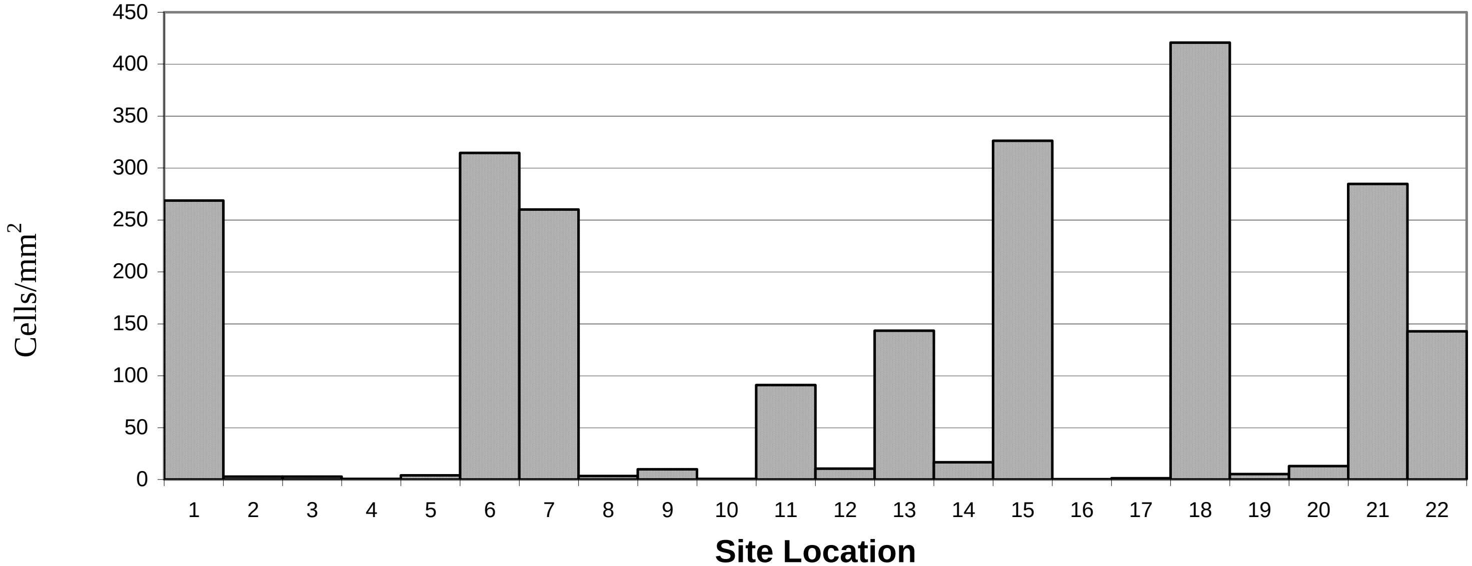


Figure 3. Number of cells per mm^2 at each location, Indian Creek watershed, Tazewell County, Virginia.

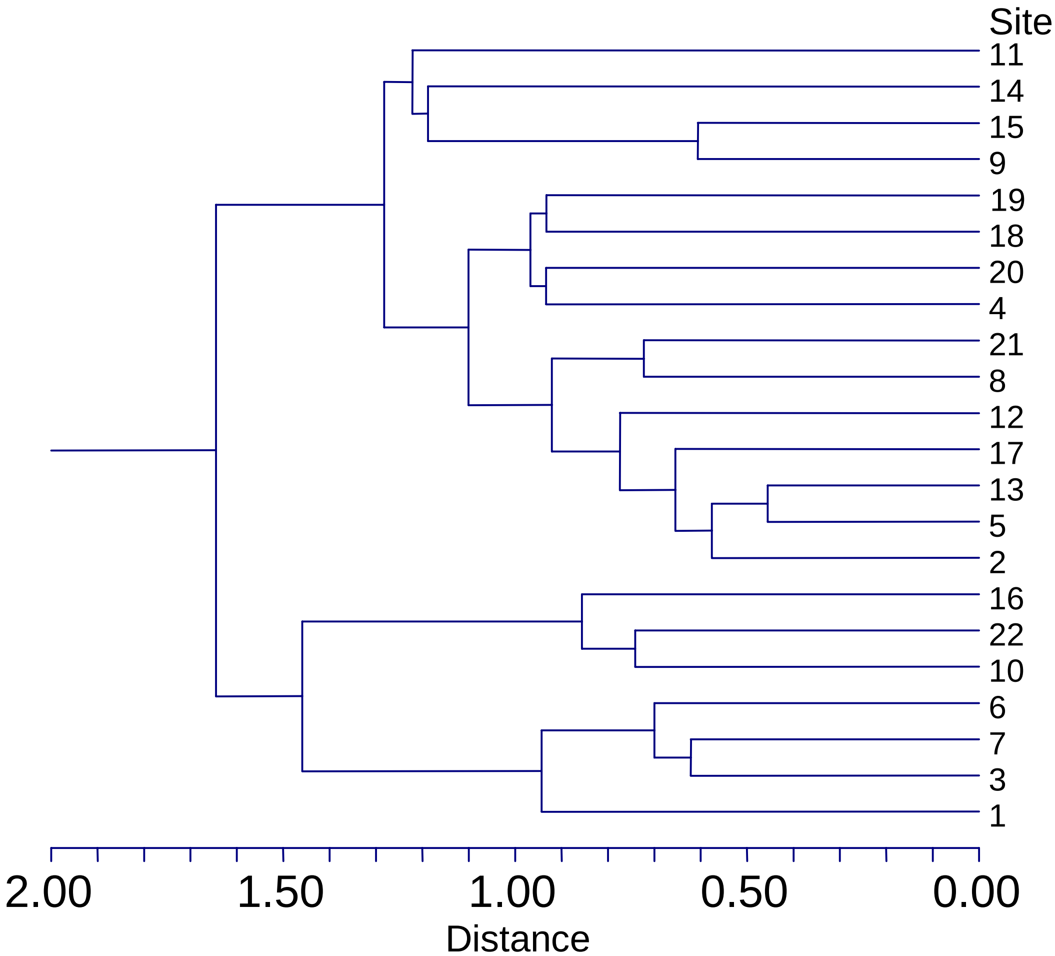


Figure 4. Comparisons of sampling sites in Indian Creek watershed, Tazewell County, Virginia, using species shared of all algal species (Jaccard's Coefficient).

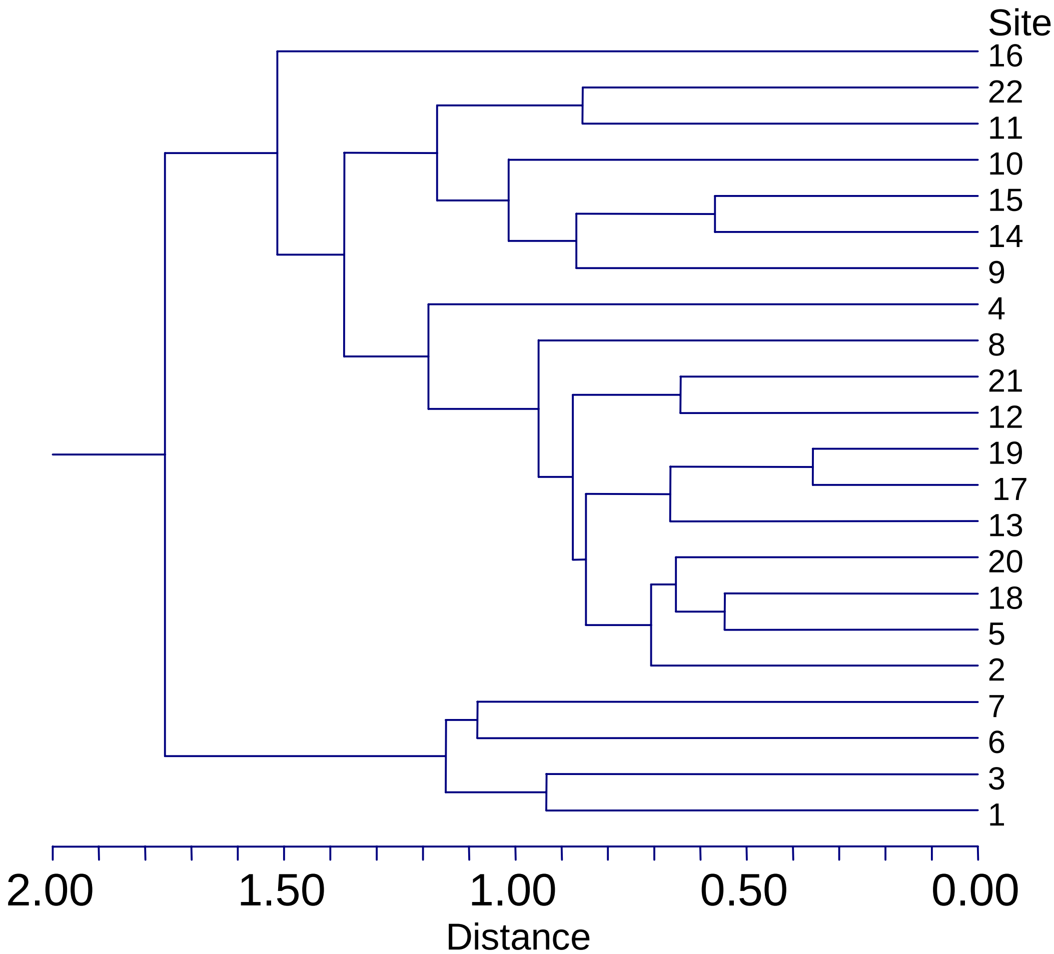


Figure 5. Comparisons of sampling sites in Indian Creek watershed, Tazewell County, Virginia, using species shared of diatom species (Jaccard's Coefficient).

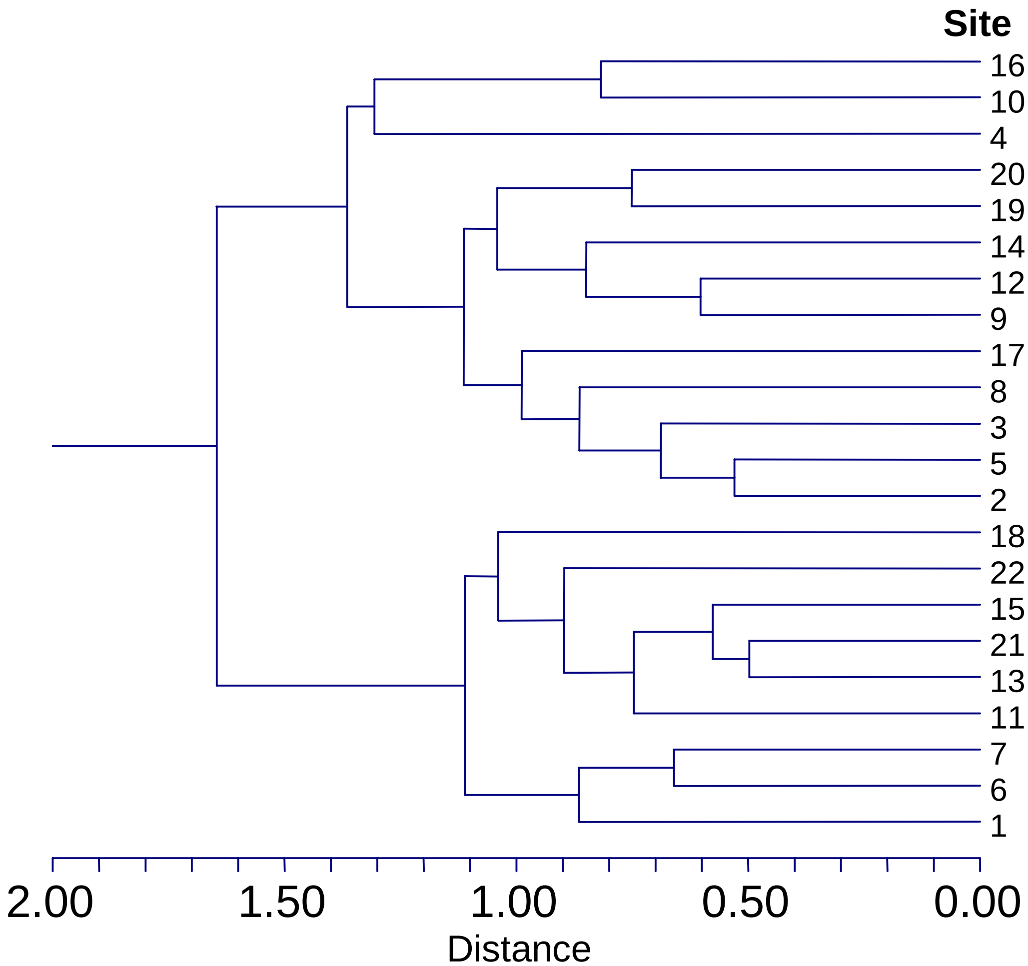


Figure 6. Comparisons of sampling sites in Indian Creek watershed, Tazewell County, Virginia, using species shared with a density component (Percent Similarity) of all algae species.

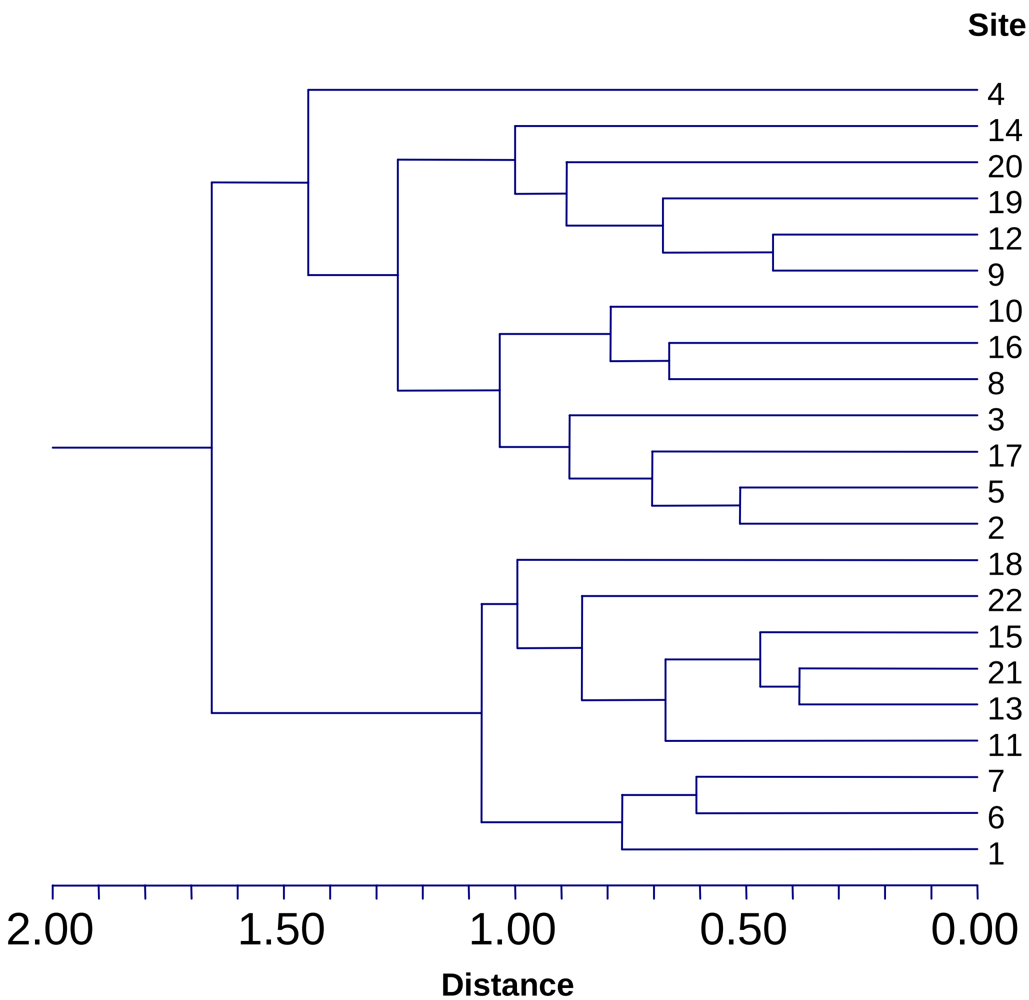


Figure 7. Comparisons of sampling sites in Indian Creek watershed, Tazewell County, Virginia, using species shared with a density component (Percent Similarity) of diatom species.

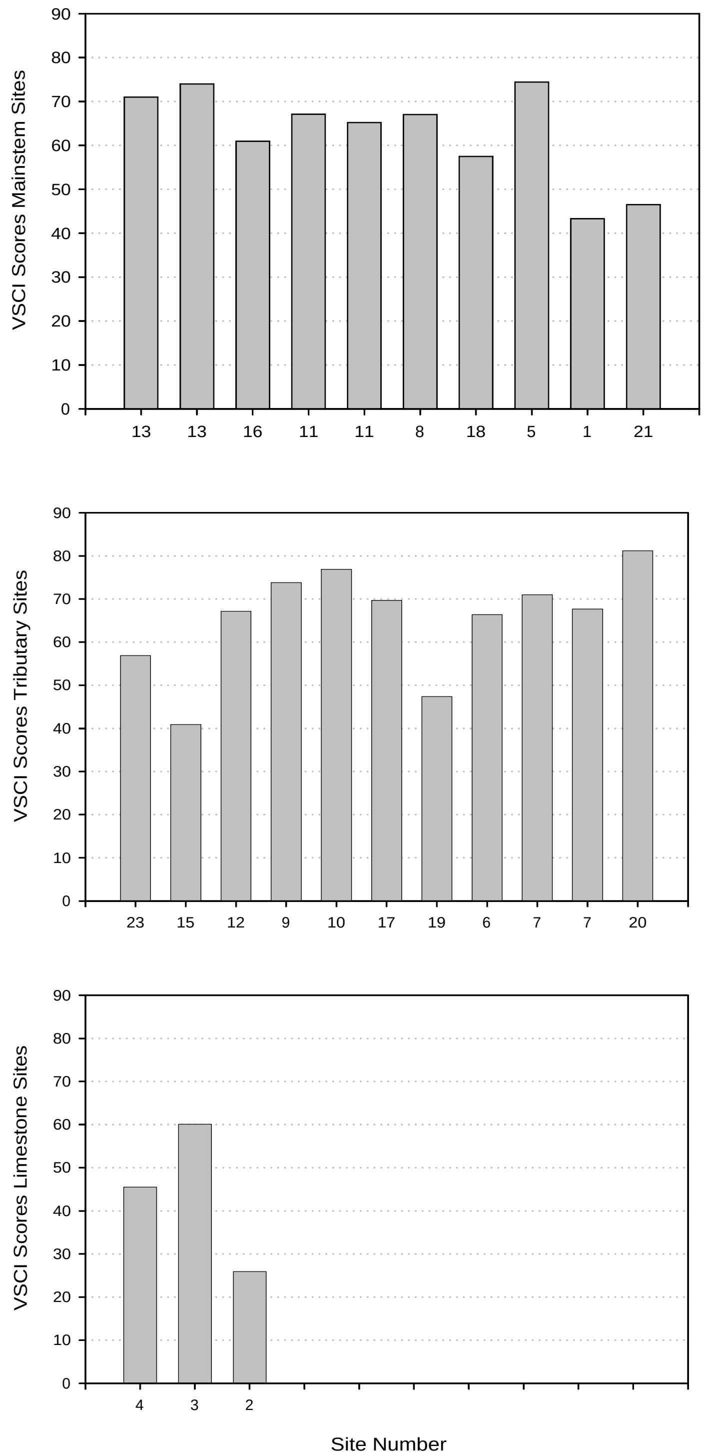


Figure 8. VSCI scores at the mainstem, tributary and limestone sites in Indian Creek, Tazewell County, Virginia, from upstream to downstream.

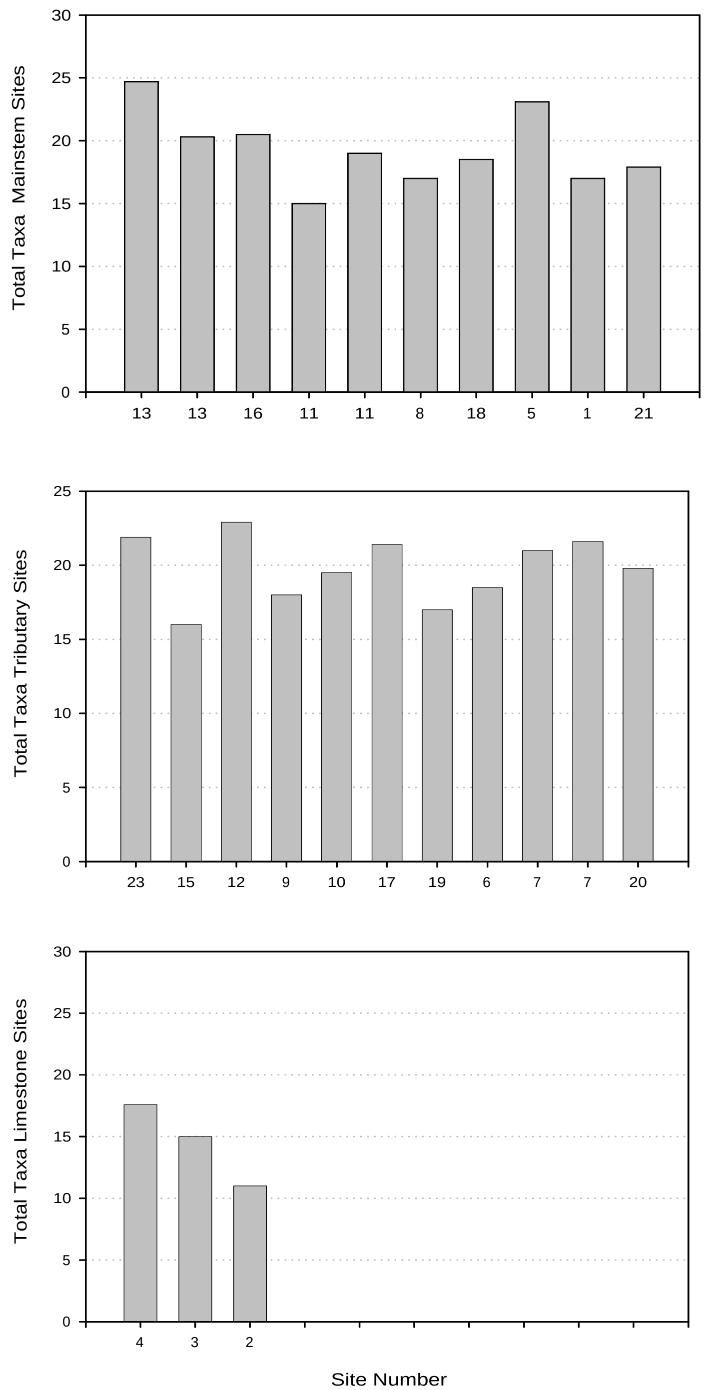


Figure 9. Total taxa metric values at the mainstem, tributary and limestone sites in Indian Creek, Tazewell County, Virginia, from upstream to downstream. (Total Taxa Values rarefied to a 200 count subsample.)

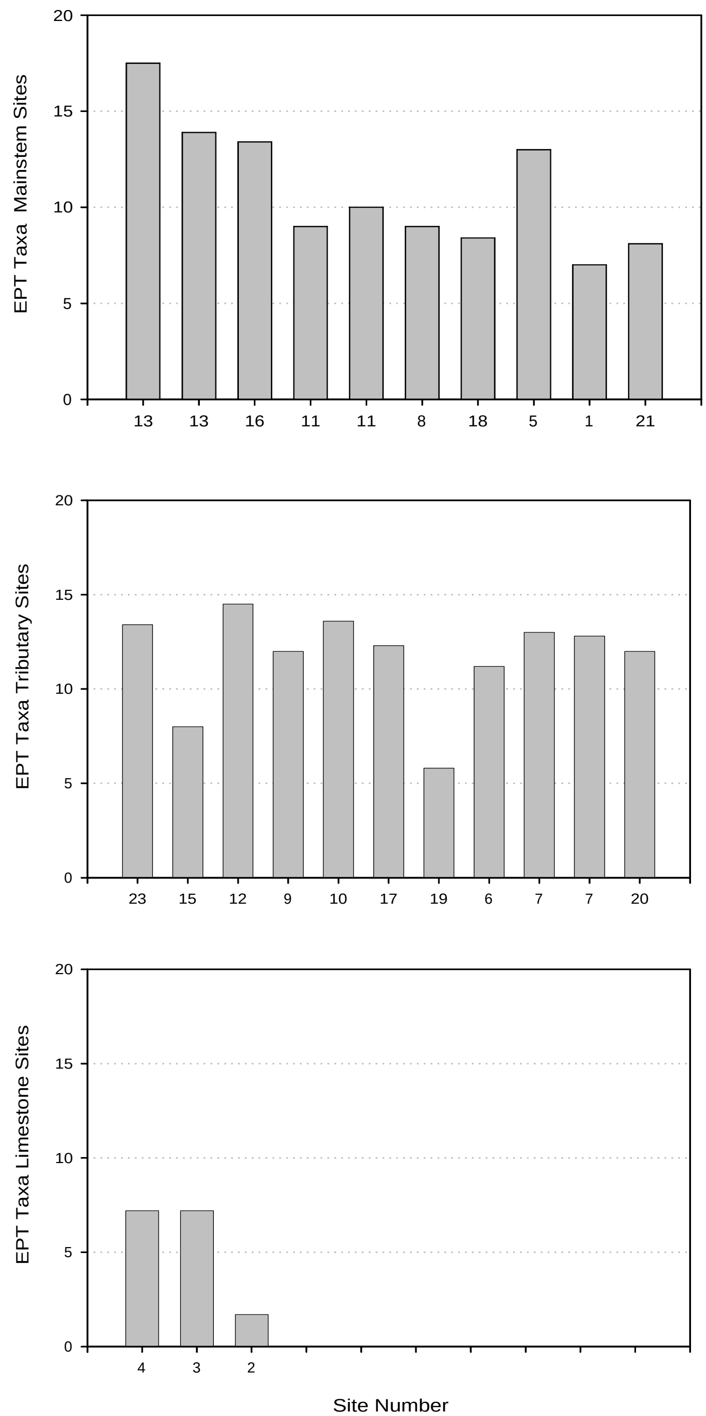


Figure 10. EPT taxa metric values at the mainstem, tributary and limestone sites in Indian Creek, Tazewell County, Virginia, from upstream to downstream. (EPT Taxa values rarefied to a 200 count subsample.)

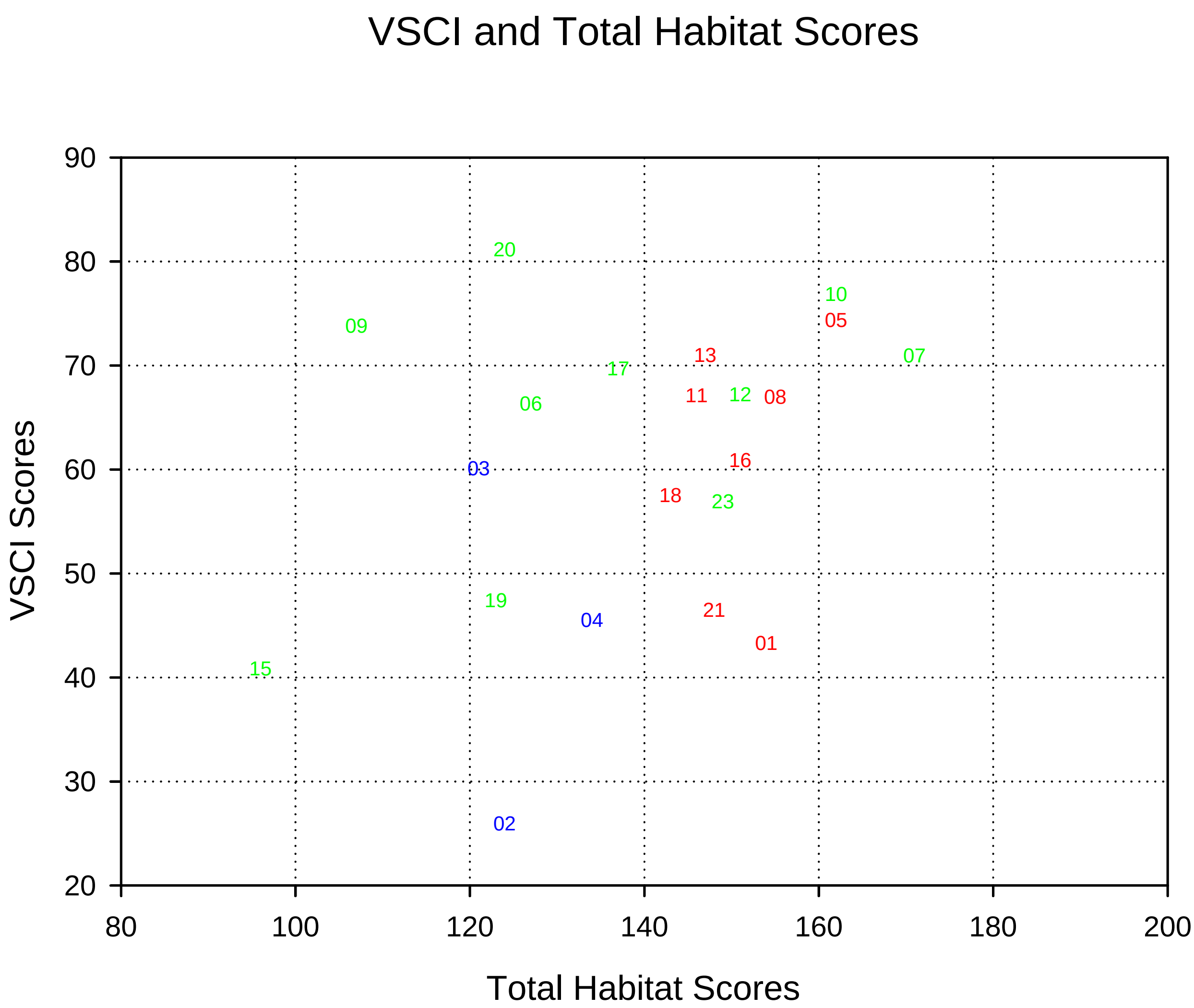


Figure 11. VSCI scores and total habitat scores for sampling sites in Indian Creek, Tazewell County, Virginia. Note that plot symbols are the site numbers, red sites are mainstem sites, green sites are tributary sites and blue sites are limestone sites. Duplicate samples are not shown.

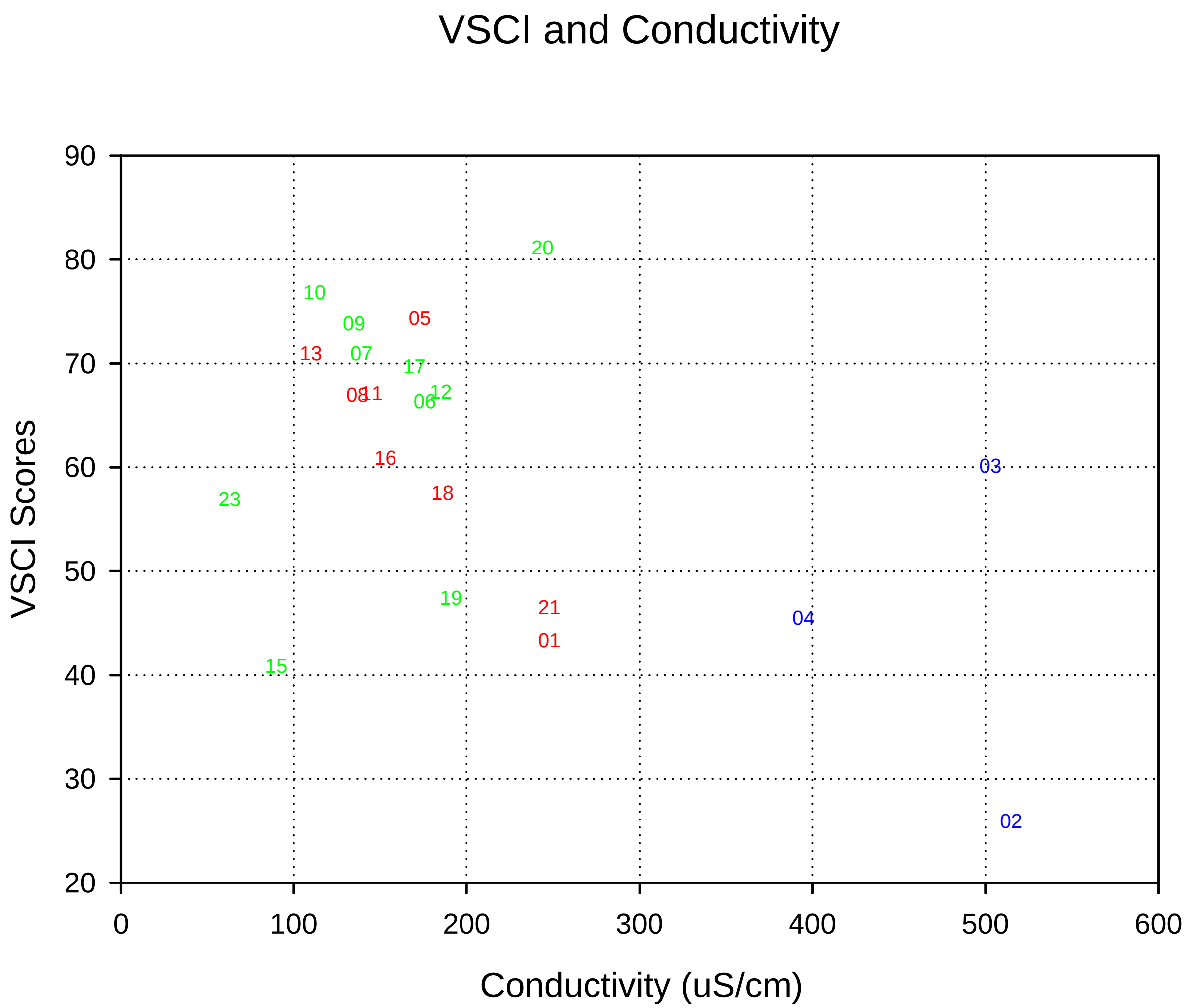
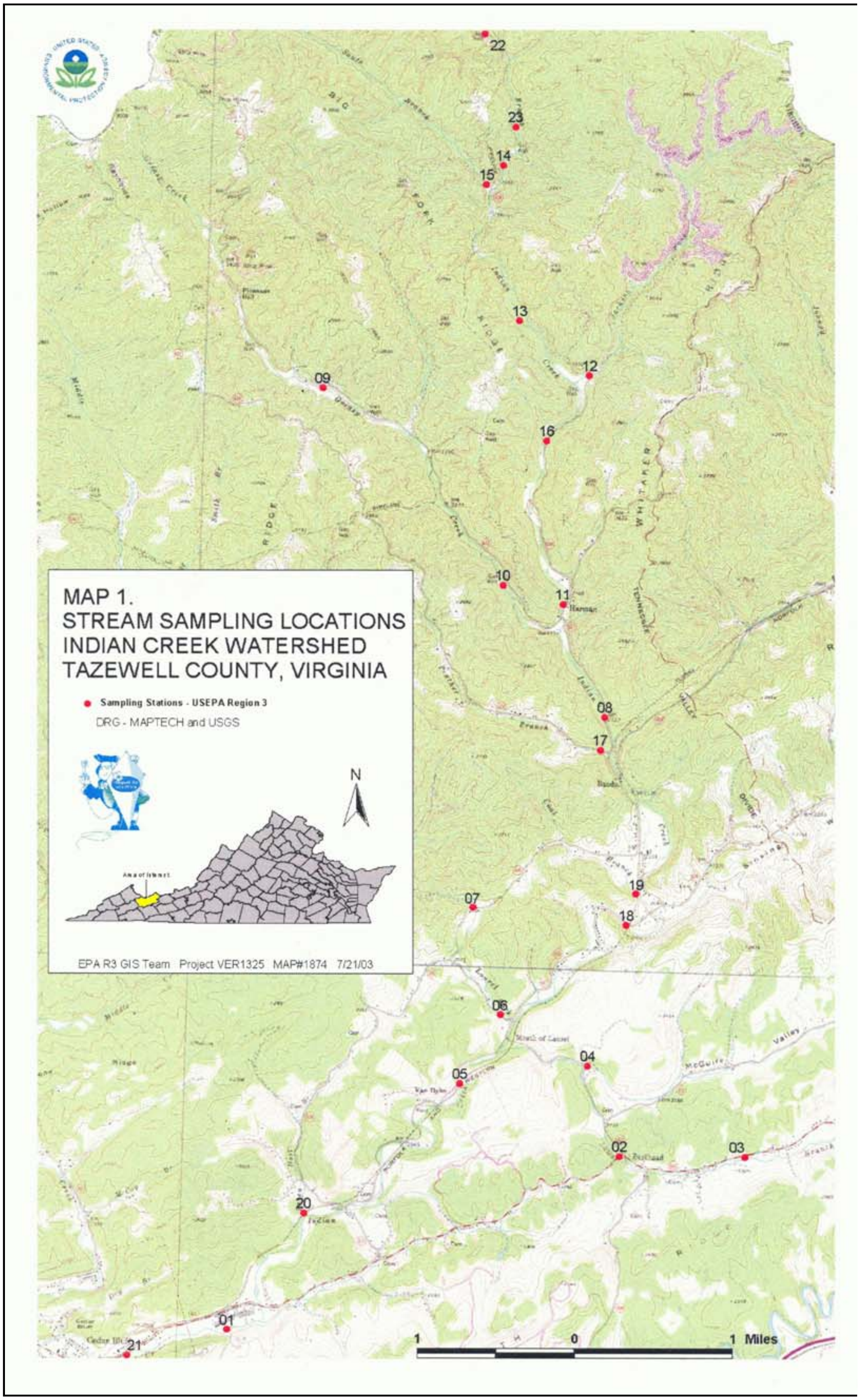
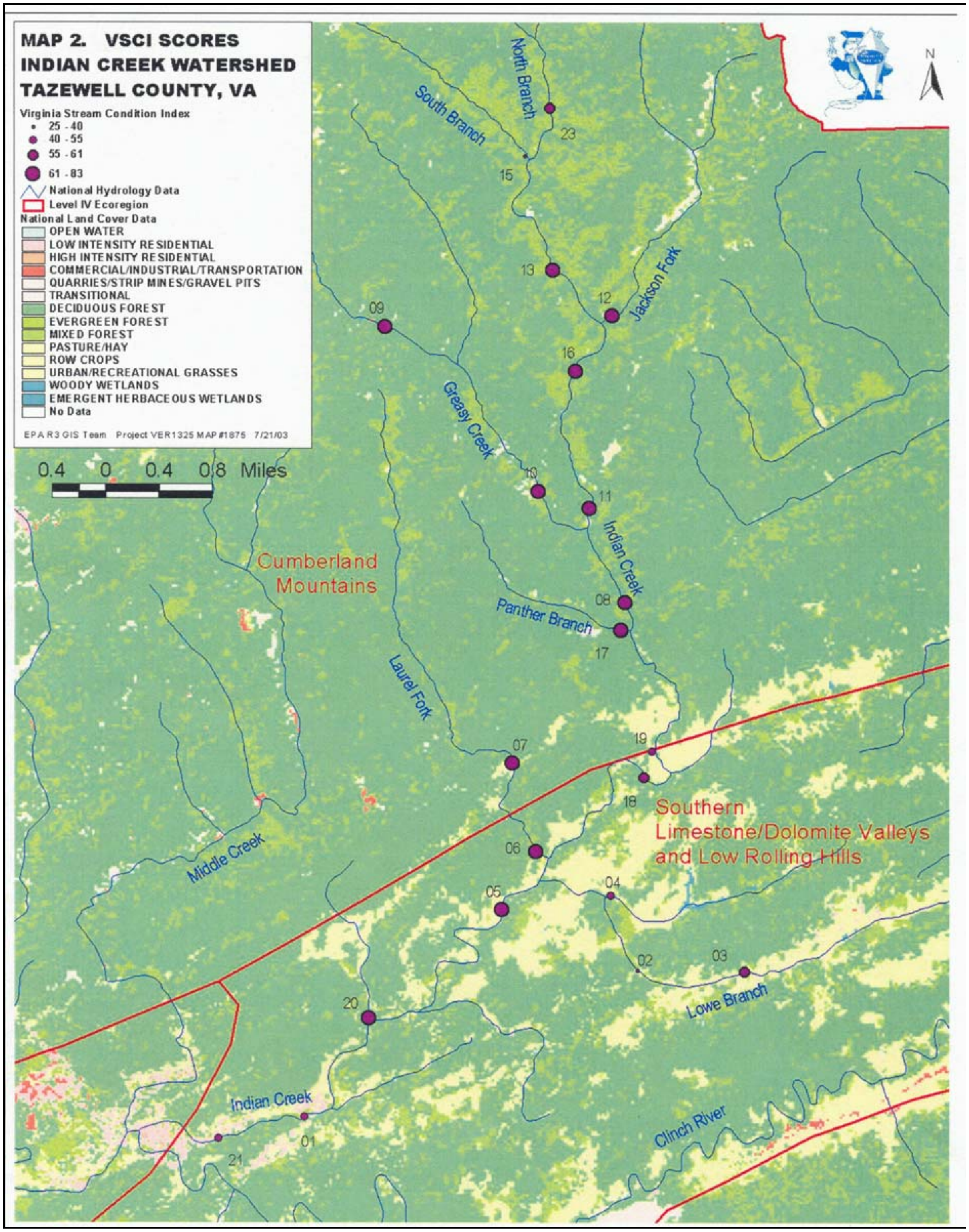
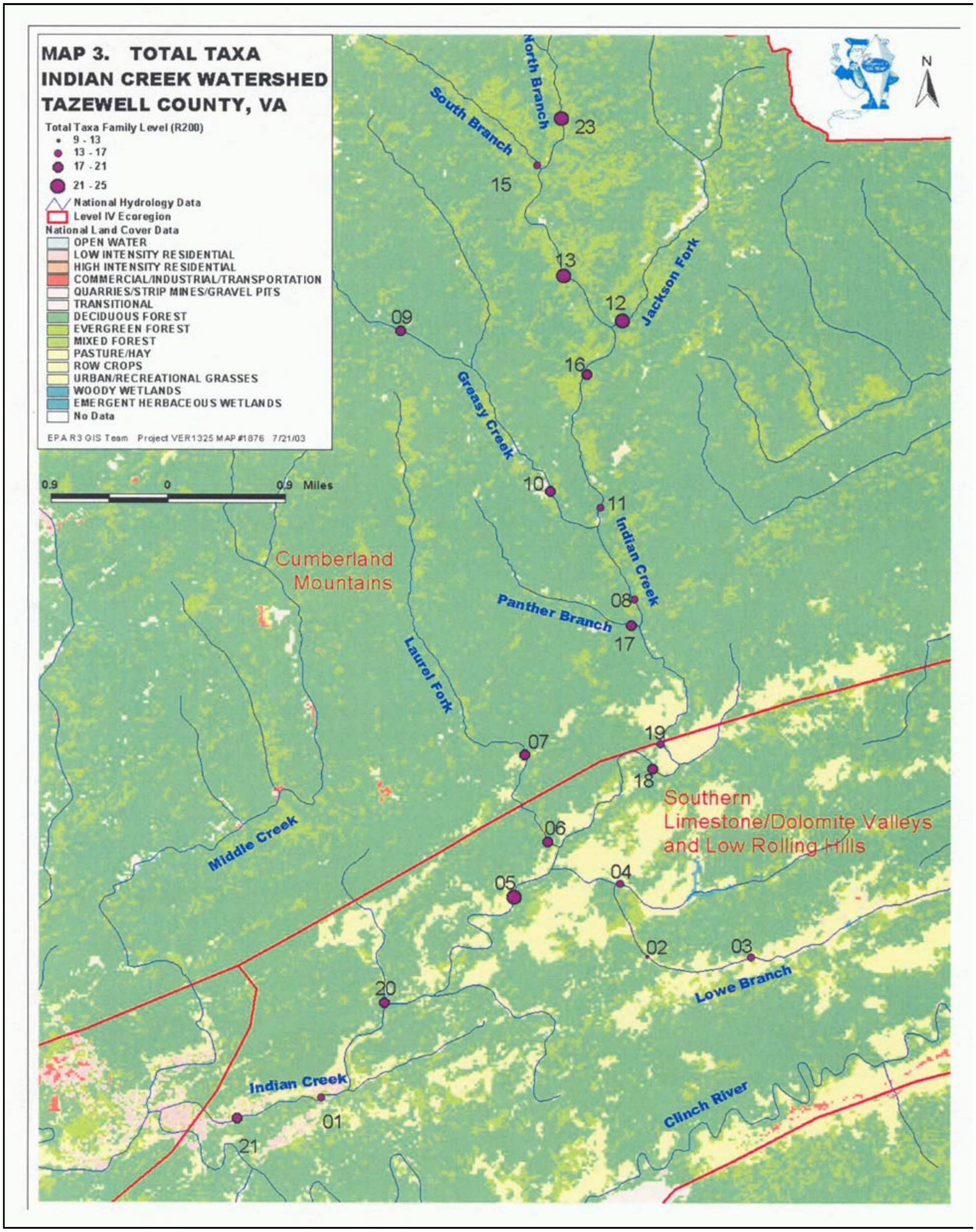
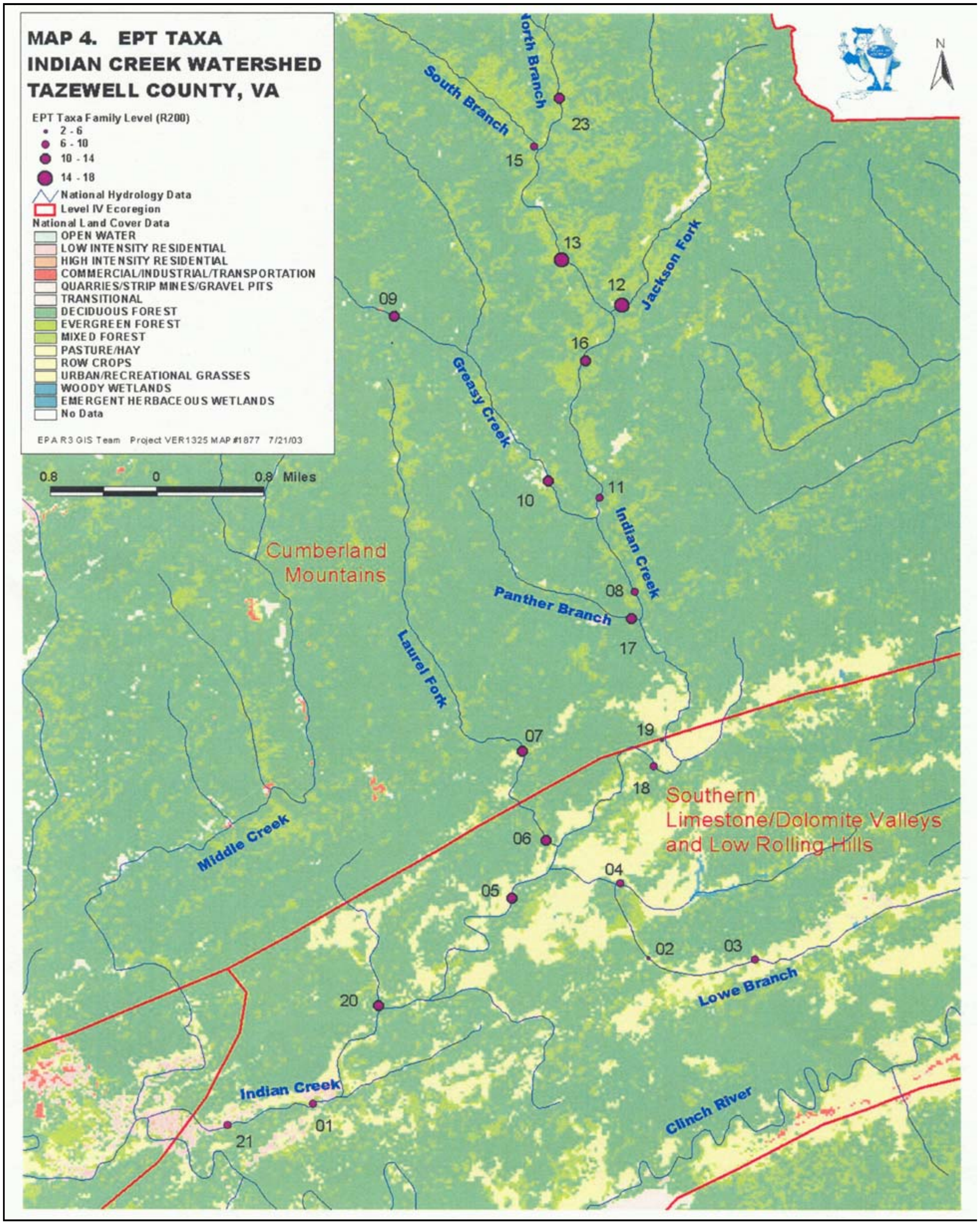


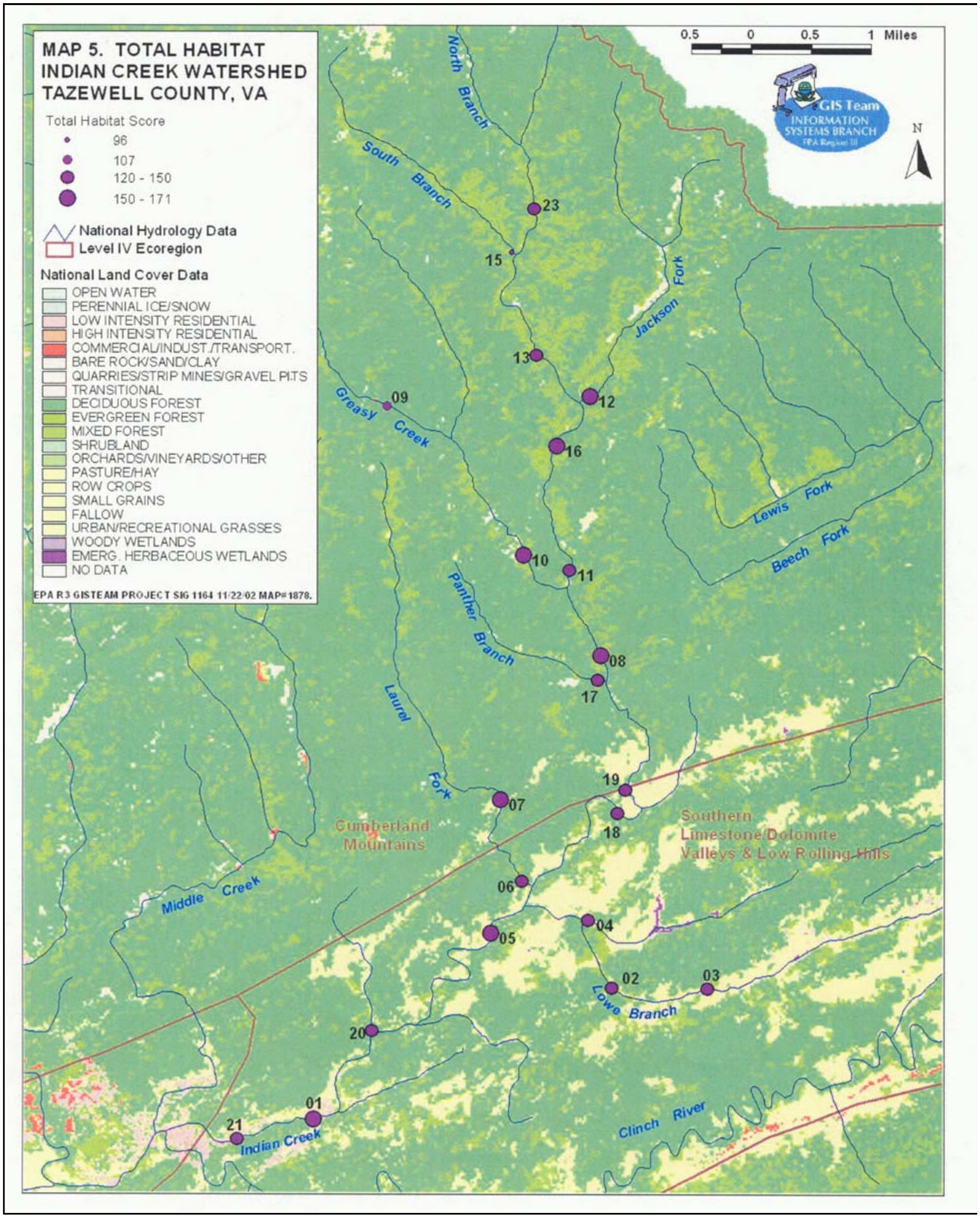
Figure 12. VSCI scores and conductivity for sampling sites in Indian Creek, Tazewell County, Virginia. Note that plot symbols are the site numbers, red sites are mainstem sites, green sites are tributary sites and blue sites are limestone sites. Duplicate samples are not shown.


MAP 1.
STREAM SAMPLING LOCATIONS
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VIRGINIA
Sampling Stations - USEPA Region 3
DRG - MAPTECH and USGS
EPA R3 GIS Team Project VER1325 MAP#1874 7/21/03
N
1 0 1 Miles
22
23
14
15
13
12
09
16
10
11
08
17
19
07
18
06
04
05
02
03
20
01
21


MAP 2. VSCI SCORES
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VA
Virginia Stream Condition Index
25 - 40
40 - 55
55 - 61
61 - 83
National Hydrology Data
Level IV Ecoregion
National Land Cover Data
OPEN WATER
LOW INTENSITY RESIDENTIAL
HIGH INTENSITY RESIDENTIAL
COMMERCIAL/INDUSTRIAL/TRANSPORTATION
QUARRIES/STRIP MINES/GRAVEL PITS
TRANSITIONAL
DECIDUOUS FOREST
EVERGREEN FOREST
MIXED FOREST
PASTURE/HAY
ROW CROPS
URBAN/RECREATIONAL GRASSES
WOODY WETLANDS
EMERGENT HERBACEOUS WETLANDS
No Data
EPA R3 GIS Team Project VER1325 MAP #1875 7/21/03
0.4 0 0.4 0.8 Miles
N
North Branch
South Branch
Jackson Fork
Greasy Creek
Indian Creek
Panther Branch
Laurel Fork
Middle Creek
Lowe Branch
Clinch River
Cumberland Mountains
Southern Limestone/Dolomite Valleys and Low Rolling Hills
23
15
13
12
09
16
10
11
08
17
07
19
18
06
04
05
02
03
20
01
21


MAP 3. TOTAL TAXA
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VA
Total Taxa Family Level (R200)
9 - 13
13 - 17
17 - 21
21 - 25
National Hydrology Data
Level IV Ecoregion
National Land Cover Data
OPEN WATER
LOW INTENSITY RESIDENTIAL
HIGH INTENSITY RESIDENTIAL
COMMERCIAL/INDUSTRIAL/TRANSPORTATION
QUARRIES/STRIP MINES/GRAVEL PITS
TRANSITIONAL
DECIDUOUS FOREST
EVERGREEN FOREST
MIXED FOREST
PASTURE/HAY
ROW CROPS
URBAN/RECREATIONAL GRASSES
WOODY WETLANDS
EMERGENT HERBACEOUS WETLANDS
No Data
EPA R3 GIS Team Project VER1325 MAP #1876 7/21/03
0.9 0 0.9 Miles
N
North Branch
South Branch
Jackson Fork
Greasy Creek
Indian Creek
Panther Branch
Laurel Fork
Middle Creek
Lowe Branch
Clinch River
Cumberland Mountains
Southern Limestone/Dolomite Valleys and Low Rolling Hills
23
15
13
12
09
16
10
11
08
17
07
19
18
06
05
04
02
03
20
01
21


MAP 4. EPT TAXA
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VA
EPT Taxa Family Level (R200)
2 - 6
6 - 10
10 - 14
14 - 18
National Hydrology Data
Level IV Ecoregion
National Land Cover Data
OPEN WATER
LOW INTENSITY RESIDENTIAL
HIGH INTENSITY RESIDENTIAL
COMMERCIAL/INDUSTRIAL/TRANSPORTATION
QUARRIES/STRIP MINES/GRAVEL PITS
TRANSITIONAL
DECIDUOUS FOREST
EVERGREEN FOREST
MIXED FOREST
PASTURE/HAY
ROW CROPS
URBAN/RECREATIONAL GRASSES
WOODY WETLANDS
EMERGENT HERBACEOUS WETLANDS
No Data
EPA R3 GIS Team Project VER1325 MAP #1877 7/21/03
0.8 0 0.8 Miles
N
North Branch
South Branch
Jackson Fork
Greasy Creek
Indian Creek
Panther Branch
Laurel Fork
Middle Creek
Lowe Branch
Clinch River
Cumberland Mountains
Southern Limestone/Dolomite Valleys and Low Rolling Hills
23
15
13
12
09
16
10
11
08
17
07
19
18
06
04
05
02
03
20
01
21


MAP 5. TOTAL HABITAT
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VA
Total Habitat Score
96
107
120 - 150
150 - 171
National Hydrology Data
Level IV Ecoregion
National Land Cover Data
OPEN WATER
PERENNIAL ICE/SNOW
LOW INTENSITY RESIDENTIAL
HIGH INTENSITY RESIDENTIAL
COMMERCIAL/INDUST./TRANSPORT.
BARE ROCK/SAND/CLAY
QUARRIES/STRIP MINES/GRAVEL PITS
TRANSITIONAL
DECIDUOUS FOREST
EVERGREEN FOREST
MIXED FOREST
SHRUBLAND
ORCHARDS/VINEYARDS/OTHER
PASTURE/HAY
ROW CROPS
SMALL GRAINS
FALLOW
URBAN/RECREATIONAL GRASSES
WOODY WETLANDS
EMERG. HERBACEOUS WETLANDS
NO DATA
EPA R3 GISTEAM PROJECT SIG 1164 11/22/02 MAP# 1878.
0.5 0 0.5 1 Miles
GIS Team
INFORMATION SYSTEMS BRANCH
N
North Branch
South Branch
Jackson Fork
Greasy Creek
Lewis Fork
Beech Fork
Panther Branch
Laurel Fork
Middle Creek
Lowe Branch
Clinch River
Indian Creek
Cumberland Mountains
Southern Limestone/Dolomite Valleys & Low Rolling Hills
23
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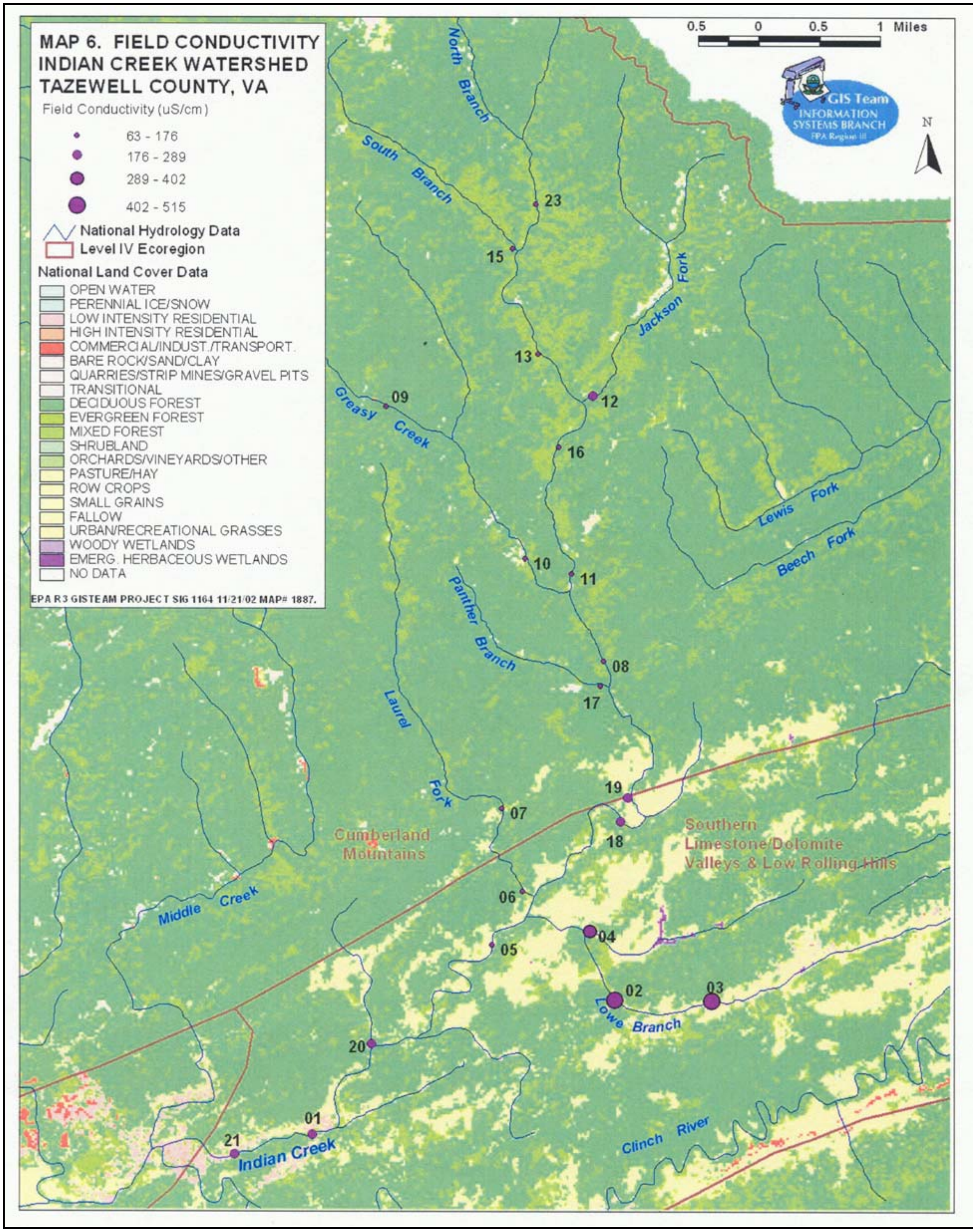

MAP 6. FIELD CONDUCTIVITY
INDIAN CREEK WATERSHED
TAZEWELL COUNTY, VA
Field Conductivity (uS/cm)
63 - 176
176 - 289
289 - 402
402 - 515
National Hydrology Data
Level IV Ecoregion
National Land Cover Data
OPEN WATER
PERENNIAL ICE/SNOW
LOW INTENSITY RESIDENTIAL
HIGH INTENSITY RESIDENTIAL
COMMERCIAL/INDUST./TRANSPORT.
BARE ROCK/SAND/CLAY
QUARRIES/STRIP MINES/GRAVEL PITS
TRANSITIONAL
DECIDUOUS FOREST
EVERGREEN FOREST
MIXED FOREST
SHRUBLAND
ORCHARDS/VINEYARDS/OTHER
PASTURE/HAY
ROW CROPS
SMALL GRAINS
FALLOW
URBAN/RECREATIONAL GRASSES
WOODY WETLANDS
EMERG. HERBACEOUS WETLANDS
NO DATA
EPA R3 GISTEAM PROJECT SIG 1164 11/21/02 MAP# 1887.
0.5 0 0.5 1 Miles
GIS Team
INFORMATION SYSTEMS BRANCH
N
North Branch
South Branch
Jackson Fork
Greasy Creek
Lewis Fork
Beech Fork
Panther Branch
Laurel Fork
Middle Creek
Cumberland Mountains
Southern Limestone/Dolomite Valleys & Low Rolling Hills
Lowe Branch
Indian Creek
Clinch River
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21

Table 1. Mussel species of the upper Clinch River watershed as compiled by S. Ahlstedt, U.S. Geological Survey.

Species	
Actinonaias ligamentina	*Leptodea fragilis*
Actinonaias pectorosa **	† *Lexingtonia dolabelloides* **
Alasmidonta marginata	*Ligumia recta*
Alasmidonta viridis	*Medionidus conradicus***
Amblema plicata	† *Pegias fabula* **
Cumberlandia monodonta	*Plethobasus cyphyus*
Cyclonaias tuberculata	*Pleurobema coccineum*
Cyprogenia stegaria	*Pleurobema cordatum*
† *Dromus dromas* **	*Pleurobema oviforme***
Elliptio crassidens	† *Pleurobema plenum*
Elliptio dilatata	*Pleurobema rubrum*
Epioblasma arcaeformis (H)**	*Potamilus alatus*
Epioblasma biemarginata (H)	*Ptychobranchus fasciolaris*
† *Epioblasma brevidens* **	† *Ptychobranchus subtentum* **
† *Epioblasma capsaeformis* **	*Quadrula cylindrica*
† *Epioblasma florentina walker* i**	*Quadrula cylindrica cylindrica* (H)
Epioblasma haysiana **	† *Quadrula cylindrica strigillata*
Epioblasma lenoir (H)**	† *Quadrula intermedia* **
Epioblasma lewisi (H)**	*Quadrula pustulosa pustulosa*
† *Epioblasma tortulosa gubernaculum* **	† *Quadrula sparsa* **
Epioblasma triquetra	*Strophitus undulatus*
Fusconaia barnesiana **	*Toxolasma lividus***
† *Fusconaia cor* **	*Truncilla truncata*
† *Fusconaia cuneolus* **	*Villosa fabalis*
Fusconaia subrotunda	*Villosa iris*
† *Hemistena lata*	† *Villosa perpurpurea* **
† *Lampsilis abrupta*	† *Villosa trabalis* **
Lampsilis fasciola	*Villosa vanuxemensis vanuxemensis* **
Lampsilis ovata	
Lampsilis ovata ventricosa	
Lasmigona costata	
Lasmigona holstonia	
Lemiox rimosus **	

(** = Cumberlandian, † = endangered, H = historical)

Table 2. Fish species of the upper Clinch River watershed.*

Species	
Ambloplites rupestris	*Lepomis cyanellus*
*Ameiurus melas***	*Lepomis gibbosus***
Ameiurus natalis	*Lepomis gulosus*
Ammocrypta clara	*Lepomis macrochirus*
Aplodinotus grunniens	*Lepomis megalotis*
Campostoma anomalum	*Lepomis microlophus***
*Carassius auratus***	*Luxilus chrysocephalus*
Carpiodes carpio	*Luxilus coccogenis*
Carpiodes cyprinus	*Lythrurus ardens*
Carpiodes velifer	*Lythrurus lirus*
Catostomus commersoni	*Macrhybopsis aestivalis*
Clinostomus funduloides	*Micropterus dolomieu*
Cottus baileyi	*Micropterus punctulatus*
Cottus bairdi	*Micropterus salmoides*
Cottus carolinae	*Morone chrysops***
Cottus sp (broadbanded sculpin)	*Morone saxatilis***
*Ctenopharyngodon idella***	*Moxostoma anisurum*
Cycleptus elongatus	*Moxostoma carinatum*
Cyprinella galactura	*Moxostoma duquesnei*
† *Cyprinella monacha* (H)	*Moxostoma erythrurum*
Cyprinella spiloptera	*Moxostoma macrolepidotum*
Cyprinella whipplei	*Nocomis micropogon*
*Cyprinus carpio***	*Notemigonus crysoleucas***
Dorosoma cepedianum	*Notropis ariommus*
*Dorosoma petenense***	*Notropis atherinoides*
*Ericymba buccata***	*Notropis leuciodus*
†*Erimystax cahni*	*Notropis photogenis*
Erimystax dissimilis	*Notropis rubellus*
Erimystax insignis	*Notropis rubricroceus*
*Esox masquinongy***	*Notropis sp*. (palezone shiner) (H)
Etheostoma blennioides	*Notropis sp.* (sawfin shiner)
Etheostoma caeruleum	*Notropis spectrunculus*
Etheostoma camurum	*Notropis telescopus*
Etheostoma cinereum	*Notropis volucellus*
Etheostoma flabellare	*Noturus eleutherus*
Etheostoma kennicotti	† *Noturus flavipinnis* (H)

** = introduced, † = endangered, H = historical record

Table 2 continued.

Species	
†*Etheostoma percnurum*	*Noturus flavus*
Etheostoma rufilineatum	*Noturus stanauli*
Etheostoma simoterum	*Oncorhynchus mykiss***
Etheostoma stigmaeum jessiae	*Percina aurantiaca*
Etheostoma swannanoa	*Percina burtoni*
Etheostoma tippecanoe	*Percina caprodes*
Etheostoma vulneratum	*Percina copelandi*
Etheostoma zonale	*Percina evides*
Fundulus catenatus	*Percina macrocephala*
*Gambusia affinis***	*Percina maculata*
Hiodon tergisus	*Percina sciera*
Hybopsis amblops	*Phenacobius crassilabrum*
Hypentelium nigricans	*Phenacobius uranops*
Ichthyomyzon bdellium	*Phoxinus erythrogaster*
Ichthyomyzon gagei	*Pimephales notatus*
Ichthyomyzon greeleyi	*Pimephales promelas***
Ictalurus furcatus	*Pimephales vigilax*
Ictalurus punctatus	*Polyodon spathula*
Ictiobus bubalus	*Pomoxis annularis*
Ictiobus cyprinellus	*Pomoxis nigromaculatus*
Ictiobus niger	*Pylodictis olivaris*
Labidesthes sicculus	*Rhinichthys atratulus*
Lampetra aepyptera	*Rhinichthys cataractae*
Lampetra appendix	*Salmo trutta***
Lepisosteus oculatus	*Salvelinus fontinalis***
Lepisosteus osseus	*Semotilus atromaculatus*
*Lepomis auritus***	*Stizostedion canadense*
	Stizostedion vitreum

** = introduced, † = endangered, H = historical record

*Jenkins, R.E. and N.M. Burkhead. 1994. *The Freshwater Fishes of Virginia* . American Fisheries Society, Bethesda, Maryland. 1,080 pp.

Table 3. Test Methods used for evaluating water and sediment samples collected in the Indian Creek watershed, Tazewell, Virginia.

Parameter	Method reference	Container	Preservative	Holding time
Aqueous				
Total Dissolved Solids (TDS)	160.1	1 L plastic	None	7 days
Total suspended Solids (TSS)	160.2	1 L plastic	None	7 Days
Total Organic Carbon (TOC)	9060	125-ml amber glass w/ teflon	HCl	28 days
Hardness, carbonate as Ca	130.2	1 L plastic	None	7 days
Total Kjeldahi Nitrogen-N	351.2	250-ml plastic	H_2SO_4	28 days
Nitrate + Nitrate	353.2	250-ml plastic	H_2SO_4	28 days
Ammonia (as N)	350.1	250-ml plastic	H_2SO_4	28 days
Phosphorus, total	365.4	250-ml plastic	H_2SO_4	28 days
Phenolics, total	9065	125-ml amber glass	H_2SO_4	28 days
Cyanide, total	9010	250-ml plastic	NaOH	14 days
Semivolatiles	8270	1 L amber glass w/ teflon	None	7days/40 days
Volatiles	8260	3 x 40-ml glass w/ teflon	HCl	14 days
Metals (except Mercury), priority pollutant	6010	500 ml Plastic	HNO_3	6 months
Mercury	7470	500 ml Plastic	HNO_3	6 months
Chlorinated Pesticides	8081	1 L amber glass w/ teflon	None	7days/40 days
PCBs as aroclors	8082	1 L amber glass w teflon	None	7days/40 days
Solids				
Cyanide, total	9010	250-ml plastic	None	14 days
Phenolics, total	9065	250-ml plastic	None	28 days
Total Organic Carbon (TOC)	9060	125-ml amber glass w/ teflon	None	28 days
Semivolatiles	8270	250-ml glass	None	7days/40 days
Volatiles	8260	125-ml glass w/ septa	None	14 days
Metals (except mercury and cadmium), priority pollutant	6010	250-ml plastic	None	6 months
Mercury	7471	250-ml plastic	None	6 months
Cadmium	7131A	250-ml plastic	None	6 months
Chlorinated Pesticides	8081	250-ml glass	None	7days/40 days
PCBs as aroclors	8082	250-ml glass	None	7days/40 days
AVS/SEM	EPA68-03-3534	250-ml plastic	None	14 days
grain size	ASTM D422	500-ml plastic	None	6 months

Table 4. Summary results of Hydrolab water quality monitoring in the Indian Creek watershed, Tazewell, Virginia, from June 13, 2001 through June 2, 2002. Values reported were averaged over the sampling period. The complete data set is located in the appendix.

Site	Receiving Water	DO	pH	Conductivity	TDS	Hardness, Carbonate
		mg/l	Units	μhos/cm	mg/l	mg/l
1	Indian Creek	9.16	7.96	253.7	167	125
2	Lowe Branch	8.79	7.87	462.3	302	255
3	Lowe Branch	8.98	7.76	499.5	310	270
4	unnamed tributary	8.67	7.84	398.0	254	215
5	Indian Creek	9.33	7.95	245.4	158	155.5
6	Laurel Fork	9.34	7.95	204.5	145	80
7	Laurel Fork	9.17	7.84	173.2	124	65.5
8	Indian Creek	9.25	7.70	160.8	134	79
9	Greasy Creek	9.20	7.61	179.7	140	77
10	Greasy Creek	9.40	7.66	142.5	111	76.5
11	Indian Creek	9.34	7.69	152.9	105	98
12	Jackson Fork	9.52	7.62	171.1	106	90
13	Indian Creek	9.45	7.57	141.2	101	65.5
14	North Branch	7.91	7.33	46.5	76	57.5
15	South Branch	7.72	7.20	101.6	69	49
16	Indian Creek	9.05	7.55	154.3	105	74
17	Panther Branch	8.76	7.73	221.2	165	95
18	Indian Creek	9.19	7.73	191.6	127	82.5
19	Coal Branch	8.82	7.72	226.4	150	108
20	Raven Nest Branch	8.79	7.89	275.3	193	145
21	Indian Creek	9.25	8.04	262.4	168	125
22	North Branch	8.49	7.37	87.3	55	50

Table 5. Positive detections in surface water collected in the Indian Creek watershed, Tazewell, Virginia, during the weeks of September 10, 2001 and May 14, 2002.

September	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Total Dissolved Solids (mg/l)	**190**	**300**	**320**	**270**	**190**	**160**	**140**
Suspended Solids (mg/l)	5.0U	5.0U	5.0U	5.0U	5.0U	**7**	**8**
Hardness, Carbonate (mg/l)	**150**	**250**	**270**	**210**	**230**	**94**	**75**
Nitrate + Nitrite-N (mg/l)	**0.23**	**0.75**	**0.82**	**0.46**	**0.34**	**0.084**	**0.16**
ammonia as N (mg/l)	0.030U	**0.022B**	0.030U	0.030U	0.030U	0.030U	0.030U
Total Phosphorus (mg/l)	0.10U	**0.068B**	**0.052B**	0.10U	0.10U	**0.065B**	**0.055B**
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	**0.26**	0.20U	0.20U	0.20U	**0.19B**	**0.13B**
Total Organic Carbon (mg/l)	**1.4**	**1.3**	**0.65B**	**1.5**	**1.6**	**2.3**	**1.8**
Phenolics, Total (mg/l)	**0.014B**	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
priority pollutants - semivolatiles (ug/l)							
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U
VOCs (ug/l)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Priority Pollutant - Metals (ug/l)							
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	3.0U	**0.83B**	3.0U	3.0U	3.0U	3.0U
copper	**3.1B**	**3.1B**	**3.7B**	**3.3B**	**3.2B**	5.0U	5.0U
lead	10U	10U	10U	10U	10U	10U	10U
nickel	5.0U	5.0U	**2.3B**	5.0U	**1.7B**	5.0U	5.0U
thallium	10U	10U	10U	10U	10U	10U	10U
zinc	10U	**3.1B**	**3.2B**	10U	**3.2B**	**2.6B**	**1.4B**

B - reported value is < the reporting limit (RL) but $\geq$ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 5 continued.

May	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**
Total Dissolved Solids (mg/l)	**97**	**270**	**280**	**240**	**86**	**99**	**77**
Suspended Solids (mg/l)	5.0U	5.0U	**5**	5.0U	5.0U	5.0U	5.0U
Hardness, Carbonate (mg/l)	**100**	**260**	**270**	**220**	**81**	**66**	**56**
Nitrate + Nitrite-N (mg/l)	**0.14**	**0.5**	**0.39**	**0.33**	**0.12**	**0.051**	**0.058**
ammonia as N (mg/l)	**0.027B**	**0.026B**	**0.03**	**0.024B**	**0.027B**	**0.024B**	**0.018B**
Total Phosphorus (mg/l)	**0.037B**	0.10U	**0.036B**	**0.056B**	0.10U	0.10U	**0.046B**
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	**0.13B**	**0.13B**	0.20U	0.20U	0.20U	0.20U
Total Organic Carbon (mg/l)	**0.90B**	**1.3**	**1.3**	**1.5**	**0.81B**	**1**	**0.82B**
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
VOCs (ug/l)							
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	**0.59J**
Priority Pollutant - metals (ug/l)							
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chromium	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U
copper	**3.7B**	**3.3B**	**3.8B**	**3.6B**	**3.7B**	**3.6B**	**3.5B**
lead	10U	10U	10U	10U	10U	10U	10U
nickel	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
zinc	**1.3B**	**2.2B**	**2.1B**	**1.1B**	**1.6B**	**3.7B**	**2.6B**

B - reported value is < the reporting limit (RL) but≥ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 5 continued.

September	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14
Total Dissolved Solids (mg/l)	**130**	**190**	**150**	**130**	**160**	**110**	**45**
Suspended Solids (mg/l)	5.0U	**8**	5.0U	5.0U	5.0U	**22**	**9**
Hardness, Carbonate (mg/l)	**79**	**99**	**98**	**98**	**87**	**54**	**43**
Nitrate + Nitrite-N (mg/l)	**0.088**	**0.057**	**0.11**	**0.092**	**0.1**	**0.14**	**0.19**
ammonia as N (mg/l)	0.030U	**0.063**	0.030U	0.030U	0.030U	0.030U	0.030U
Total Phosphorus (mg/l)	0.10U	**0.061B**	**0.057B**	**0.049B**	0.10U	**0.073B**	**0.037B**
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.20U	0.20U	0.20U	0.20U	**0.15B**	**0.25**
Total Organic Carbon (mg/l)	**1.3**	**0.90B**	**1.3**	**1.4**	**1.3**	**2.1**	**3.3**
Phenolics, Total (mg/l)	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	**0.0074B**	**0.0077B**	0.010U	0.010U	0.010U	0.010U
PP - SVOC (ug/l)							
bis(2-ethylhexyl)phthalate	**0.70J**	**0.91J**	**0.90J**	10U	10U	10U	10U
VOCs (ug/l)	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
PP - metals (ug/l)							
arsenic	**3.5B**	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	**1.2B**	**0.92B**	**0.85B**	3.0U	3.0U	3.0U	3.0U
copper	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	**8.5**
lead	10U	10U	**2.6B**	10U	10U	10U	10U
nickel	5.0U	5.0U	5.0U	5.0U	5.0U	**1.4B**	**1.7B**
thallium	10U	10U	10U	10U	10U	10U	10U
zinc	10U	**0.83B**	**4.9B**	10U	10U	**1.4B**	**70**

B - reported value is < the reporting limit (RL) but≥ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 5 continued.

May	**Site 8**	**Site 9**	**Site 10**	**Site 11**	**Site 12**	**Site 13**	**Site 14**
Total Dissolved Solids (mg/l)	130	**73**	**61**	**130**	**120**	**94**	**190**
Suspended Solids (mg/l)	5.0U	5.0U	5.0U	5.0U	**8**	**5**	**240**
Hardness, Carbonate (mg/l)	**79**	**55**	**55**	**98**	**93**	**77**	**72**
Nitrate + Nitrite-N (mg/l)	**0.067**	**0.15**	**0.094**	**0.075**	**0.14**	**0.081**	**0.032B**
ammonia as N (mg/l)	**0.025B**	**0.043**	**0.038**	**0.025B**	**0.022B**	**0.034**	**0.16**
Total Phosphorus (mg/l)	0.049B	**0.046B**	0.10U	**0.045B**	**0.038B**	0.10U	**0.33**
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	**0.87**
Total Organic Carbon (mg/l)	**0.85B**	**0.61B**	**0.84B**	**1.1**	**0.81B**	**1.2**	**1.2**
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
VOCs (ug/l)							
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
PP - metals (ug/l)							
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	**6.5**
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	**1.2**
chromium	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	**11**
copper	**3.3B**	**2.7B**	**2.3B**	**3.2B**	**3.0B**	**3.0B**	**17**
lead	10U	10U	10U	10U	10U	10U	**6.3B**
nickel	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	**16**
zinc	**1.3B**	**1.6B**	**1.6B**	**1.6B**	**1.3B**	**2.3B**	**57**

B - reported value is < the reporting limit (RL) but≥ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 5 continued.

September	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Total Dissolved Solids (mg/l)	**86**	**120**	**220**	**160**	**160**	**220**	**190**	**50**
Suspended Solids (mg/l)	**32**	**22**	5.0U	5.0U	5.0U	**75**	5.0U	95
Hardness, Carbonate (mg/l)	**53**	**75**	**120**	**97**	**120**	**170**	**150**	50
Nitrate + Nitrite-N (mg/l)	0.050U	**0.092**	**0.14**	**0.11**	**0.13**	**0.48**	**0.14**	**0.043B**
ammonia as N (mg/l)	**0.11**	0.030U	0.030U	0.030U	**0.021B**	0.030U	0.030U	**0.23**
Total Phosphorus (mg/l)	**0.067B**	0.10U	**0.13**	**0.043B**	**0.067B**	**0.14**	**0.041B**	**0.098B**
Total Kjeldahl Nitrogen-N (mg/l)	**0.25**	0.20U	**0.83**	0.20U	**0.25**	**1**	0.20U	**0.65**
Total Organic Carbon (mg/l)	**2.6**	**2**	**1.3**	**1.5**	**2.6**	**1.6**	**2**	**3.2**
Phenolics, Total (mg/l)	0.050U	0.050U	**0.012B**	0.050U	**0.022B**	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
PP - SVOC (ug/l)								
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U	10U
VOCs (ug/l)	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
benzene	1.0U	1.0U	1.0U	**0.19J**	1.0U	**0.16J**	1.0U	1.0U
PP - metals (ug/l)								
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	**0.75B**	**1.9B**	3.0U	3.0U	**0.83B**	3.0U	**0.86B**
copper	5.0U	5.0U	**3.3B**	5.0U	**0.61B**	**0.81B**	**3.6B**	5.0U
lead	10U	10U	**3.6B**	10U	10U	10U	10U	10U
nickel	**2.6B**	5.0U	**1.7B**	5.0U	5.0U	5.0U	**1.4B**	**1.4B**
thallium	10U	10U	10U	10U	10U	10U	**6.7B**	10U
zinc	**3.6B**	**2.0B**	**14**	10U	**0.82B**	**2.0B**	10U	**3.9B**

B - reported value is < the reporting limit (RL) but ≥ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 5 continued.

May	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Total Dissolved Solids (mg/l)	**60**	**87**	**73**	**84**	**110**	**120**	**120**	**63**
Suspended Solids (mg/l)	**9**	5.0U	5.0U	5.0U	5.0U	**130**	5.0U	**8**
Hardness, Carbonate (mg/l)	**45**	**73**	**70**	**68**	**96**	**120**	**100**	**50**
Nitrate + Nitrite-N (mg/l)	**0.05**	**0.085**	**0.1**	**0.76**	**0.072**	**0.28**	**0.12**	**0.07**
ammonia as N (mg/l)	**0.037**	**0.028B**	**0.066**	**0.020B**	**0.11**	**0.08**	**0.024B**	**0.092**
Total Phosphorus (mg/l)	0.10U	**0.035B**	**0.049B**	0.10U	**0.034B**	**0.067B**	**0.037B**	**0.04B**
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.20U	0.20U	0.20U	0.20U	**0.27**	0.20U	0.20U
Total Organic Carbon (mg/l)	**0.98B**	**1**	**1**	**0.70B**	**2**	**1.2**	**2**	**1.5**
Cyanide, Total (mg/l)	0.010U	0.010U	**0.0085B**	0.010U	0.010U	0.010U	0.010U	0.010U
VOCs (ug/l)								
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
PP - metals (ug/l)								
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chromium	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U
copper	**3.1B**	**3.6B**	**3.1B**	**7.0**	**3.1B**	**3.0B**	**3.3B**	**3.1B**
lead	10U	10U	10U	10U	10U	10U	10U	10U
nickel	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
zinc	**5.5B**	**1.9B**	**2.3B**	**1.3B**	**2.0B**	**3.8B**	**1.8B**	**1.9B**

B - reported value is < the reporting limit (RL) but ≥ to the method detection limit (MDL)

J - compound meets the identification criteria, but the result is less than the RL and greater than the MDL

U - concentration below RL

Table 6. Results of fecal coliform analysis from samples collected in the Indian Creek Watershed, Tazewell, Virginia.

	Sep-01	May-02
	Colonies/100ml	Colonies/100ml
	1 ml dilution	1 ml dilution
Site 1	600	800
Site 2	7600	6500
Site 3	200	700
Site 4	200	5300
Site 5	100	1000
Site 6	1500	4300
Site 7	<100	200
Site 8	<100	<100
Site 9	100	<100
Site 10	<100	<100
Site 11	100	100
Site 12	400	<100
Site 13	<100	100
Site 14	<100	<100
Site 15	<100	100
Site 16	<100	<100
Site 17	100	1800
Site 18	300	100
Site 19	100	1600
Site 20	400	1200
Site 21	<100	1100
Site 22	<100	200

Negative and commercial positive controls run daily:

	10-Sep-01	11-Sep-01	12-Sep-01
Negative Control X1	0	0	0
Negative Control X2	0	0	0
Positive Control	27 colonies	26 colonies	23 colonies

	14-May-02
Negative Control X1	0
Negative Control X2	0
Positive Control	30 colonies

Table 7. Summary analytical results of sediment analysis conducted on samples collected in the Indian Creek watershed, Tazewell, Virginia.

September	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
SVOCs (ug/kg)							
anthracene	550U	**130J**	480U	590U	460U	**32J**	460U
benzo(a)anthracene	550U	**330J**	480U	590U	460U	**170J**	460U
benzo(a)pyrene	550U	**260J**	480U	590U	460U	**170J**	460U
benzo(b)fluoranthene	550U	**250J**	480U	590U	460U	**240J**	460U
benzo(g,h,I)perylene	550U	**170J**	480U	590U	460U	**110J**	460U
benzo(k)fluoranthene	550U	**270J**	480U	590U	460U	**120J**	460U
bis(2-ethylhexyl)phthalate	550U	**180J**	480U	590U	460U	480U	460U
chrysene	550U	**380J**	480U	590U	460U	**230J**	460U
3,3'-dichlorobenzidine	1100U	1000U	970U	1200U	920U	**970J**	920U
di-n-butylphthalate	550U	520U	480U	590U	460U	480U	460U
fluoranthene	550U	**830**	480U	590U	460U	**520**	460U
indeno(1,2,3-cd)pyrene	550U	**140J**	480U	590U	460U	480U	460U
phenanthrene	550U	**390J**	480U	590U	460U	**290J**	460U
pyrene	550U	**680**	480U	590U	460U	**420J**	460U
Chlorinated Pesticides (ug/kg)							
4,4'-DDD	**1.6J**	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U
VOCs (ug/kg)							
methylene chloride	13U	11U	13U	16U	7.5U	8.2U	**3.4J**
Metals (mg/kg)							
antimony	**0.76BN**	**0.67BN**	**0.68BN**	**1.0BN**	**2.5UN**	**2.7UN**	**0.65BN**
arsenic	**5.6**	**11**	**9.7**	**23**	**5**	**2**	**3.9**
beryllium	**0.86**	**1.1**	**1.3**	**1.2**	**0.54**	**0.37**	**0.52**
chromium	**8.5**	**21**	**32**	**76**	**5.2**	**3**	**4**
copper	**9.7**	**15**	**10**	**260**	**3.8**	**2.8**	**4.5**
lead	**9.7**	**15**	**16**	**26**	**7.4**	**3.6B**	**5.8B**
nickel	**11**	**20**	**18**	**18**	**6.3B**	**4.0B**	**6.5**
thallium	1.5U	**6.7B**	**1.4B**	1.8U	1.3U	1.3U	**1.3**
zinc	**47**	**88**	**84**	**55**	**30**	**20**	**25**
cadmium	**0.11B**	**0.14B**	**0.17B**	**0.26B**	**0.038B**	**0.046B**	**0.058B**
mercury	**0.013B**	**0.017B**	**0.018B**	**0.021B**	**0.028B**	**0.0076B**	**0.0065B**
TOC (mg/kg)	**9600**	**12000**	**29000**	**26000**	**5300**	**8900**	**8200**
AVS (mg/kg)	**28**	**96**	**37**	**400**	14U	15U	14U
AVS metals (mg/kg)							
cadmium	**0.084B**	**0.14**	**0.11**	**0.23**	**0.033B**	**0.037B**	**0.040B**
copper	**2.1**	**4.2**	**2.4**	**2.3**	**1.2**	**1.3**	**2.1**
nickel	**1.2**	**2.2**	**1.6**	**1.2**	**1**	**1.1**	**1.2**
zinc	**9.6E**	**24E**	**21E**	**8.7E**	**7.4E**	**8.5E**	**6.7E**
lead	**4.2**	**8.6**	**10**	**13**	**3.4**	**2.5**	**2.2**
Grain Size							
%gravel	26.1	24.2	19.8	50.3	44.6	0	0
%sand	66.8	65.1	47.4	40.4	47.7	95.7	89.1
%silt	6	10.3	26.3	7.2	6.8	3.2	10.1
%clay	1.1	0.4	6.5	2.1	0.9	1.1	0.8

B (inorganic) - reported value is less than the Project Reporting Limit but > the Method Detection Limit
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is < the RL and > the MDL
U - compound was analyzed for but not detected

W - due to matrix interference the analytical spike for site 11 was not within acceptable limits for cadmium

Table 7 continued

September	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14
SVOCs (ug/kg)							
anthracene	480U	490U	440U	480U	530U	460U	560U
benzo(a)anthracene	480U	490U	440U	480U	530U	460U	560U
benzo(a)pyrene	480U	490U	440U	480U	530U	460U	560U
benzo(b)fluoranthene	480U	490U	440U	480U	530U	460U	560U
benzo(g,h,I)perylene	480U	490U	440U	480U	530U	460U	560U
benzo(k)fluoranthene	480U	490U	440U	480U	530U	460U	560U
bis(2-ethylhexyl)phthalate	480U	490U	440U	480U	530U	460U	560U
chrysene	480U	490U	440U	480U	530U	460U	560U
3,3'-dichlorobenzidine	960U	980U	890U	960U	1100U	920U	1100U
di-n-butylphthalate	480U	490U	440U	480U	530U	460U	560U
fluoranthene	480U	490U	440U	480U	530U	460U	560U
indeno(1,2,3-cd)pyrene	480U	490U	440U	480U	530U	460U	560U
phenanthrene	480U	490U	440U	480U	530U	460U	560U
pyrene	480U	490U	440U	480U	530U	460U	560U
Chlorinated Pesticides (ug/kg)							
4,4'-DDD	4.8U	4.9U	4.4U	4.8U	5.3U	4.6U	5.6U
VOCs (ug/kg)							
methylene chloride	14U	14U	15U	23U	29U	**2.2J**	**3.5J**
Metals (mg/kg)							
antimony	**2.6UN**	**0.70BN**	**2.5UN**	**2.9UN**	**2.9UN**	**0.80BN**	**3.1UN**
arsenic	**3.7**	**6.6**	**3.6**	**4.4**	**3**	**3**	**3.7**
beryllium	**0.51**	**1.1**	**0.65**	**1**	**0.6**	**0.64**	**0.72**
chromium	**3.7**	**7.7**	**5.7**	**5.2**	**3.6**	**4.5**	**5**
copper	**3.4**	**11**	**8.5**	**6.7**	**15**	**4.3**	**5**
lead	**5.0B**	**14**	**6.5**	**8.3**	**6.6B**	**5.0B**	**5.6B**
nickel	**6.0B**	**13**	**9.4**	**8.9**	**6.8B**	**9**	**7.9**
thallium	**1.3B**	1.5U	**2.6**	1.4U	**2.9**	**1.2B**	1.5U
zinc	**27E**	**76E**	**43E**	**40E**	**30E**	**30**	**28**
cadmium	**0.029B**	**0.033B**	**0.048B**	**0.079BW**	**0.076B**	**0.044B**	**0.060B**
mercury	0.026U	**0.013B**	0.023U	0.026U	**0.018B**	0.025U	**0.022B**
TOC (mg/kg)	**6700**	**9100**	**9000**	**9000**	**21000**	**6800**	**15000**
AVS (mg/kg)	15U	15U	14U	15U	16U	14U	**18**
AVS metals (mg/kg)							
cadmium	**0.051B**	**0.062B**	**0.053B**	**0.049B**	**0.059B**	**0.056B**	0.12U
copper	**1.4**	**2.6**	**1.1**	**1.7**	**10**	**1.4**	**0.028B**
nickel	**1.4**	**1.1**	**1**	**1.6**	**1.7**	**2.2**	**0.057B**
zinc	**7.5**	**10**	**11**	**8**	**9.6**	**7.9E**	**0.18BE**
lead	**2.5**	**4.6**	**2.1**	**2.8**	**2.5**	**2.5**	0.12U
Grain Size							
%gravel	0.2	2.4	7.4	1.5	0	10.9	0
%sand	73	89.1	91.7	46.1	95.6	82.1	90.6
%silt	26.2	7.7	0.8	51.6	2	5.7	8.1
%clay	0.6	0.8	0.1	0.8	2.4	1.3	1.3

B (inorganic) - reported value is less than the Project Reporting Limit but > the Method Detection Limit
N (inorganic) - spiked sample recovery is not within control limits
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J - presence of a compound meets the identification criteria, but the result is < the RL and > the MDL
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W - due to matrix interference the analytical spike for site 11 was not within acceptable limits for cadmium

Table 7 continued

September	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
SVOCs (ug/kg)								
anthracene	890U	440U	540U	470U	**48J**	610U	470U	870U
benzo(a)anthracene	890U	440U	540U	470U	**52J**	610U	470U	870U
benzo(a)pyrene	890U	440U	540U	470U	480U	610U	470U	870U
benzo(b)fluoranthene	890U	440U	540U	470U	**42J**	610U	470U	870U
benzo(g,h,I)perylene	890U	440U	540U	470U	480U	610U	470U	870U
benzo(k)fluoranthene	890U	440U	540U	470U	**17J**	610U	470U	870U
bis(2-ethylhexyl)phthalate	890U	440U	540U	470U	480U	610U	470U	870U
chrysene	890U	440U	540U	470U	**51J**	610U	470U	870U
3,3'-dichlorobenzidine	1800U	890U	1100U	940U	970U	1200U	940U	1700U
di-n-butylphthalate	890U	440U	540U	470U	480U	610U	**41J**	870U
fluoranthene	890U	440U	540U	470U	**140J**	610U	470U	870U
indeno(1,2,3-cd)pyrene	890U	440U	540U	470U	480U	610U	470U	870U
phenanthrene	890U	440U	540U	470U	**150J**	610U	470U	870U
pyrene	890U	440U	540U	470U	**99J**	610U	470U	870U
Chlorinated Pesticides (ug/kg)								
4,4'-DDD	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
VOCs (ug/kg)								
methylene chloride	**8.2J**	11U	20U	8.7U	11U	18U	30U	**7.6J**
Metals (mg/kg)								
antimony	**5.4UN**	**2.3UN**	**0.76BN**	**2.4UN**	**2.5UN**	**3.4UN**	**0.61BN**	**1.3BN**
arsenic	**5.2**	**5.9**	**9.3**	**1.9**	**9.3**	**7**	**10**	**3.5**
beryllium	**1.9**	**0.62**	**1**	**0.35**	**0.5**	**0.56**	**0.67**	**1.4**
chromium	**12**	**5.3**	**11**	**3.2**	**7.7**	**9.1**	**11**	**9**
copper	**21**	**5.1**	**13**	**2.6**	**3.6**	**11**	**7.9**	**12**
lead	**16**	**5.8**	**16**	**4.8B**	**6.2**	**12**	**11**	**11B**
nickel	**21**	**8.1**	**14**	**4.9B**	**7.7**	**13**	**13**	**15**
thallium	**2.4B**	**1.5**	**2**	**1.0B**	1.2U	**1.2B**	1.3U	2.4U
zinc	**69**	**30E**	**76E**	**22E**	**33E**	**71E**	**49**	**46**
cadmium	**0.19B**	**0.041B**	**0.048B**	**0.032B**	**0.044B**	**0.12B**	**0.062B**	**0.15B**
mercury	**0.038B**	**0.0072B**	**0.010B**	0.029U	**0.0099B**	**0.027B**	**0.0084B**	**0.038B**
TOC (mg/kg)	**50000**	**11000**	**12000**	**4300**	**8000**	**48000**	**3700**	**50000**
AVS (mg/kg)	27U	14U	16U	14U	15U	**57**	14U	**28**
AVS metals (mg/kg)								
cadmium	**0.16B**	**0.058B**	**0.096B**	**0.040B**	**0.056B**	**0.16**	**0.049B**	**0.16B**
copper	**7.4**	**2**	**3.2**	**1.1**	**1.5**	**5.5**	**3.9**	**6.2**
nickel	**3.7**	**1.4**	**1.5**	**0.87**	**1**	**2.8**	**1.6**	**3.3**
zinc	**11E**	**6.4**	**16**	**7.6**	**8.8**	**30**	**12E**	**12E**
lead	**7.7**	**2.7**	**4**	**2.3**	**2.6**	**8.2**	**5.4**	**7.6**
Grain Size								
%gravel	0	16.3	15.1	0	0	34.1	10.9	0
%sand	17.9	78.3	73.1	98	88.6	54.6	85.1	72
%silt	71	3.9	9.8	1.2	7.2	9.2	2.6	23.9
%clay	11.1	1.5	2	0.8	4.2	2.1	1.4	4.1

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U - compound was analyzed for but not detected

W - due to matrix interference the analytical spike for site 11 was not within acceptable limits for cadmium

Table 7 continued

May	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
SVOCs (ug/kg)							
anthracene	540U	**250J**	1000U	530U	430U	**39J**	410U
benzo(a)anthracene	540U	**520J**	1000U	530U	430U	**150J**	410U
benzo(a)pyrene	540U	**410J**	1000U	530U	430U	**130J**	410U
benzo(b)fluoranthene	540U	920U	1000U	530U	430U	460U	410U
benzo(g,h,I)perylene	540U	**270J**	1000U	530U	430U	**80J**	410U
benzo(k)fluoranthene	540U	**390J**	1000U	530U	430U	**110J**	410U
bis(2-ethylhexyl)phthalate	540U	**180J**	**190J**	530U	430U	460U	410U
chrysene	540U	**540J**	1000U	530U	430U	**200J**	410U
fluoranthene	540U	**1100**	1000U	530U	430U	**280J**	410U
indeno(1,2,3-cd)pyrene	540U	**260J**	1000U	530U	430U	460U	410U
phenanthrene	540U	**850J**	1000U	530U	430U	**290J**	410U
pyrene	540U	**1000**	1000U	530U	430U	**500**	410U
Chlorinated Pesticides (ug/kg)							
alpha-BHC	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U
delta-BHC	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U
4,4'-DDT	11U	18U	21U	**3.8J**	4.3U	4.6U	4.1U
endrin aldehyde	11U	18U	21U	11U	4.3U	4.6U	4.1U
heptachlor	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U
VOCs (ug/kg)							
chlorobenzene	8.4U	13U	13U	5.4U	5.9U	35U	14U
Phenolics, Total (mg/kg)	**1.3B**	**4**	1.6U	**0.32B**	**0.54B**	0.7U	**0.85B**
Metals (mg/kg)							
antimony	**2.7UN**	**5.6UN**	**5.7UN**	**2.7UN**	**2.4UN**	**2.8UN**	**2.3UN**
arsenic	**4.1**	**11**	**31**	**17**	**1.9**	**2.3**	**2.6**
beryllium	**0.5**	**1.3**	**2.9**	**0.93**	**0.32**	**0.29**	**0.42**
chromium	**5.6N**	**28N**	**84N**	**38N**	**3.5N**	**3.7N**	**7.4N**
copper	**7.4NE***	**22NE***	**25NE***	**13NE***	**4.4NE***	**4.0NE***	**3.9NE***
lead	**8.7E**	**34E**	**50E**	**24E**	**6.0E**	**4.8BE**	**4.9BE**
nickel	**9**	**22**	**40**	**19**	**5.4B**	5.2B	**5.7**
thallium	1.4U	2.8U	2.8U	1.3U	1.2U	1.4U	1.1U
zinc	**38NE**	**120NE**	**270NE**	**69NE**	**27NE**	**25NE**	**24NE**
cadmium	**0.12B**	**0.33B**	**0.27B**	**0.21B**	**0.038B**	**0.028B**	**0.035B**
mercury	**0.017B**	**0.047B**	**0.39B**	**0.21B**	**0.0066B**	**0.0061B**	**0.0063B**
TOC (mg/kg)	20000	43000	44000	23000	7600	3800	5100
AVS (mg/kg)	16U	**330**	**340**	16U	13U	14U	13U
AVS metals (mg/kg)							
cadmium	0.044B	**0.19B**	**0.24**	**0.23**	**0.032B**	**0.020B**	0.021B
copper	2.1	**7.1**	**6.5**	**2.8**	**0.84**	**0.96**	0.71
nickel	1.5	**3.6**	**3.5**	**1.2**	**0.57B**	**0.37B**	0.60B
zinc	7.6NE	**45NE**	**55NE**	**57NE**	**4.4NE**	**3.4NE**	4.8NE
lead	3.4E	**16E**	**17E**	**8.5E**	**1.7E**	**1.4E**	2.2E
Grain Size							
%gravel	3.9	13.0	31.4	2.9	4.9	0	3.7
%sand	79.7	42.4	37	60.3	92.1	95.5	92
%silt	12.7	33.0	21.4	29.1	2.2	2.8	3.2
%clay	3.7	11.6	10.2	7.7	0.8	1.7	1.1

B (inorganic) - value is less than the reporting limit (RL) but > the method detection limit (MDL)

N (inorganic) - spiked sample recovery is not within control limits

E (inorganic) - reported value is estimated because of the presence of interference

J - presence of a compound meets the identification criteria, but the result is < the RL and > the MDL

U - compound was analyzed for but not detected

P - identification of target analyte thru GC is based on retention times. Two dissimilar GC columns confirmed the presence of the target analyte, but relative percent difference is >40%

* - duplicate analysis not within control limits.

Table 7 continued

May	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14
SVOCs (ug/kg)							
anthracene	460U	460U	490U	460U	430U	410U	560U
benzo(a)anthracene	460U	460U	490U	460U	430U	410U	560U
benzo(a)pyrene	460U	460U	490U	460U	430U	410U	560U
benzo(b)fluoranthene	460U	460U	490U	460U	430U	410U	560U
benzo(g,h,I)perylene	460U	460U	490U	460U	430U	410U	560U
benzo(k)fluoranthene	460U	460U	490U	460U	430U	410U	560U
bis(2-ethylhexyl)phthalate	460U	460U	490U	460U	430U	**120J**	**290J**
chrysene	460U	460U	490U	460U	430U	410U	560U
fluoranthene	460U	460U	490U	460U	430U	410U	560U
indeno(1,2,3-cd)pyrene	460U	460U	490U	460U	430U	410U	560U
phenanthrene	460U	460U	490U	460U	430U	410U	560U
pyrene	460U	460U	490U	460U	430U	410U	560U
Chlorinated Pesticides (ug/kg)							
alpha-BHC	2.4U	2.4U	2.5U	2.4U	2.2U	2.1U	2.9U
delta-BHC	2.4U	2.4U	2.5U	2.4U	2.2U	2.1U	2.9U
4,4'-DDT	**0.79J**	4.6U	4.9U	4.6U	4.3U	4.1U	5.6U
endrin aldehyde	4.6U	4.6U	4.9U	4.6U	4.3U	4.1U	5.6U
heptachlor	2.4U	2.4U	2.5U	2.4U	2.2U	2.1U	2.9U
VOCs (ug/kg)							
chlorobenzene	35U	21U	8.3U	8.7U	8.8U	12U	8.1U
Phenolics, Total (mg/kg)	**0.48B**	**2**	0.75U	**0.44B**	0.65U	0.63U	0.85U
Metals (mg/kg)							
antimony	**2.6UN**	**0.64BN**	**2.7UN**	**2.5UN**	**2.4UN**	**2.5UN**	**3.1UN**
arsenic	**1.5**	**4.3**	**2**	**1.2**	**1.6**	**2.4**	**3.2**
beryllium	**0.42**	**0.73**	**0.48**	**0.3**	**0.28**	**0.51**	**0.78**
chromium	**3.2N**	**7.8**	**4.1**	**2.7N**	**2.6N**	**4.6N**	**7.4N**
copper	**4.0NE***	**6.6**	**4.2**	**2.5NE***	**2.4NE***	**4.3NE***	**9.1NE***
lead	**4.7BE**	**8.9**	**5.9B**	**3.7BE**	**3.8BE**	**4.7BE**	**12E**
nickel	**5.2B**	**8.6**	**6.1B**	**4.2B**	**4.3B**	**6.9**	**11**
thallium	1.3U	1.4U	1.4U	1.3U	1.2U	1.2U	1.5U
zinc	**23NE**	**40E**	**26E**	**18NE**	**19NE**	**27NE**	**35NE**
cadmium	**0.033B**	**0.040B**	**0.051B**	**0.034B**	**0.038B**	**0.035B**	**0.052B**
mercury	0.026U	**0.011B**	**0.016B**	0.028U	**0.022B**	0.0086U	**0.023B**
TOC (mg/kg)	5400	5600	16000	2300	27000	9400	36000
AVS (mg/kg)	14U	14U	15U	14U	13U	12U	17U
AVS metals (mg/kg)							
cadmium	**0.013B**	**0.020B**	**0.020B**	**0.023B**	**0.023B**	**0.013B**	**0.022B**
copper	**0.8**	**1.9**	**1.1**	**0.76**	**0.84**	**1**	**1.3**
nickel	**0.63B**	**0.72B**	**0.78B**	**0.62B**	**1**	**0.8**	**0.68B**
zinc	**3.7NE**	**7.5N**	**4.5N**	**4.7NE**	**5.9NE**	**3.4NE**	**2.4NE**
lead	**8.6E**	**2.9**	**1.6**	**1.3E**	**1.2E**	**1.0E**	**3.6E**
Grain Size							
%gravel	0	3	3.2	0	5.6	10.8	19.9
%sand	96.6	91.1	86.7	97.2	86.9	84.7	53.9
%silt	2.5	3.8	9	1.9	6.5	2.9	16.9
%clay	0.9	2.1	1.1	0.9	1	1.6	9.3

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* - duplicate analysis not within control limits.

Table 7 continued

May	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
SVOCs (ug/kg)								
anthracene	500U	430U	460U	470U	500U	570U	550U	660U
benzo(a)anthracene	500U	430U	460U	470U	500U	**52J**	550U	660U
benzo(a)pyrene	500U	430U	460U	470U	500U	**54J**	550U	660U
benzo(b)fluoranthene	500U	430U	460U	470U	500U	**77J**	550U	660U
benzo(g,h,I)perylene	500U	430U	460U	470U	500U	**56J**	550U	660U
benzo(k)fluoranthene	500U	430U	460U	470U	500U	**46J**	550U	660U
bis(2-ethylhexyl)phthalate	500U	430U	460U	470U	500U	570U	550U	660U
chrysene	500U	430U	460U	470U	500U	**80J**	550U	660U
fluoranthene	500U	430U	460U	470U	500U	**120J**	550U	660U
indeno(1,2,3-cd)pyrene	500U	430U	460U	470U	500U	570U	550U	660U
phenanthrene	500U	430U	460U	470U	500U	**31J**	**32J**	660U
pyrene	500U	430U	460U	470U	500U	570U	550U	660U
Chlorinated Pesticides (ug/kg)								
alpha-BHC	2.6U	2.2U	2.4U	2.4U	**0.38JP**	**0.98JP**	2.8U	6.8U
delta-BHC	2.6U	2.2U	2.4U	2.4U	2.6U	**0.25JP**	2.8U	6.8U
4,4'-DDT	5.0U	4.3U	4.6U	4.7U	**1.4J**	**0.74JP**	5.5U	13U
endrin aldehyde	5.0U	4.3U	4.6U	**0.35JP**	5.0U	5.7U	5.5U	13U
heptachlor	2.6U	2.2U	2.4U	2.4U	**0.33JP**	**0.45JP**	2.8U	6.8U
VOCs (ug/kg)								
chlorobenzene	12U	19U	**3.8J**	5.2U	38U	23U	6.5U	19U
Phenolics, Total (mg/kg)	**0.39B**	**1.3**	0.69U	**1.1B**	1.7U	**1.8**	**1.7**	1.0U
Metals (mg/kg)								
antimony	**3.0UN**	**2.4UN**	**2.5UN**	**2.6UN**	**1.0BN**	**3.1UN**	**3.0UN**	**3.6UN**
arsenic	**5.7**	**0.84**	**4.9**	**2.8**	**6.9**	**9.3**	**5.7**	**2.4**
beryllium	**1.1**	**0.26**	**0.83**	**0.34**	**0.56**	**0.49**	**0.45**	**0.97**
chromium	**9.9N**	**2.4N**	**10**	**3.5N**	**7.9**	**9.1**	**6.3N**	**7.2N**
copper	**15NE***	**2.5NE***	**9.5**	**3.8NE***	**7.3**	**9.5**	**7.2NE***	**11NE***
lead	**20E**	**3.0BE**	**11**	**8.0E**	**17**	**11**	**9.2E**	**10E**
nickel	**13**	**4.1B**	**9.2**	**7**	**11**	**12**	**9.4**	**13**
thallium	**0.78B**	1.2U	1.3U	1.3U	1.4U	1.6U	1.5U	1.8U
zinc	**44NE**	**16NE**	**53E**	**28NE**	**67E**	**51E**	**42NE**	**45NE**
cadmium	**0.056B**	**0.025B**	**0.038B**	**0.060B**	**0.050B**	**0.086B**	**0.16B**	**0.10B**
mercury	**0.021B**	**0.0066B**	**0.013B**	**0.0083B**	**0.017B**	**0.024B**	**0.018B**	**0.023B**
TOC (mg/kg)	18000	2300	5400	9600	7000	14000	5900	99000
AVS (mg/kg)	15U	13U	14U	14U	15U	17U	17U	20U
AVS metals (mg/kg)								
cadmium	**0.34B**	**0.020B**	**0.038B**	0.021B	**0.025B**	**0.030B**	**0.071B**	**0.042B**
copper	**1.4**	**0.93**	**1.2**	0.82	**1.8**	**1.7**	**2.6**	**2.8**
nickel	**0.68B**	**0.51B**	**0.61B**	0.52B	**0.89**	**1.2**	**1.7**	**2**
zinc	**1.9NE**	**3.5NE**	**9.2N**	4.2NE	**7.4N**	**6.1N**	**12NE**	**7.1NE**
lead	**2.4E**	**1.2E**	**3.7**	1.4E	**2.6**	**2.9**	**4.3E**	**3.6E**
Grain Size								
%gravel	4.3	0	1.4	0	5.1	0.8	1.7	0.5
%sand	74	90.2	83.7	97.3	86.9	38.7	89.1	60.6
%silt	16.3	9.1	14	1.8	4.5	49.4	6.9	33.7
%clay	5.4	0.7	0.9	0.9	3.5	11.1	2.3	5.2

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Table 8. Summary results of grain size analysis compared with total acid volatile sulfide analysis.

		Sep-01		May-02	
site	Stream Drainage (sq mi)	avs (mg/kg)	grain size as % sand + gravel	avs (mg/kg)	grain size as % sand + gravel
1	32.80	28	92.9	16U	83.6
2	2.24	96	89.3	330	55.4
3	1.44	37	67.2	340	68.4
4	1.50	400	90.7	16U	63.2
5	28.62	14U	92.3	13U	97.0
6	3.82	15U	95.7	14U	95.5
7	3.07	14U	89.1	13U	95.7
8	16.10	15U	73.2	14U	96.6
9	1.89	15U	91.5	14U	94.1
10	4.49	14U	99.1	15U	89.9
11	10.99	15U	47.6	14U	97.2
12	2.74	16U	95.6	13U	92.5
13	6.57	14U	93.0	12U	95.5
14	3.43	18	90.6	17U	73.8
15	2.33	27U	17.9	15U	78.3
16	9.97	14U	94.6	13U	90.2
17	0.87	16U	88.2	14U	85.1
18	19.42	14U	98.0	14U	97.3
19	0.66	15U	88.6	15U	92.0
20	1.18	57	88.7	17U	39.5
21	-	14U	96.0	17U	90.8
22	2.10	28	72.0	20U	61.1

U - compound was analyzed for but not detected

Table 9. Physio-chemical properties, Indian Creek Watershed, Tazewell, Virginia, July 25, 2001.

Site	Temp	DO (mg/l)	Conductivity	pH	Turbidity	Width (ft)	Depth (ft)	Velocity (ft/sec)	Flow	Substrate
1	24.3	7.38	0.2663	8.10	Clear	30	0.9	0.3	8.1	Bedrock, some cobble
2	21.9	7.37	0.4664	7.87	Clear	4	0.4	1	1.6	Gravel and silt
3	19.9	7.12	0.4976	7.71	Clear	2	0.12	1.9	0.5	Gravel and silt
4	21.3	6.75	0.412	7.28	Opaque	1.5	0.26	0.6	0.2	mostly gravel with boulder and cobble
5	22.7	8.02	0.2738	8.00	Clear	20	0.8	0.3	4.8	Cobble, gravel and sand
6	23.2	7.89	0.2591	7.95	Clear	9	0.26	1.1	2.6	mostly bedrock some gravel and cobble
7	19.9	7.69	0.1927	7.70	Clear	6	0.4	1.1	2.6	Cobble and gravel
8	23.6	8.27	0.1752	8.12	Clear	18	0.5	0.4	3.6	Cobble and gravel
9	21.2	7.83	0.2023	7.30	Clear	3	0.2	0.7	0.4	Silt
10	22	7.53	0.1719	7.62	Clear	2.5	0.3	0.8	0.6	Cobble, gravel and boulders
11	21.6	8.08	0.1754	8.00	Clear	12	0.6	0.4	2.9	Cobble, gravel and boulders
12	18	8.61	0.1782	7.43	Clear	11.5	0.8	0.4	3.7	Cobble, gravel, sand and silt
13	19.2	8.48	0.1865	7.66	Clear	8.5	0.4	0.3	1	Cobble, some gravel
14	17	4.36	0.122	6.48	Turbid	17	0.6	0.2	2	Silt with sand and gravel
15	17	7.31	0.127	6.86	Clear	4	0.3	0.4	0.5	Gravel and cobble
16	20.4	7.04	0.1778	7.18	Slightly Turbid	13	0.9	0.4	4.7	Cobble, gravel sand and silt
17	20.8	6.91	0.3119	7.54	Clear	3	0.4	0.2	0.2	Silt with gravel
18	23.7	8.17	0.2057	8.04	Clear	18	0.3	1	5.4	Gravel with cobble
19	22.1	6.5	0.2897	7.35	Slightly Turbid	3	0.3	0.4	0.4	Silt, gravel, sand and cobble
20	21.5	7.53	0.305	7.87	Slightly Turbid	3.5	0.3	1.2	1.3	Cobble with gravel
21	24.7	7.23	0.2696	8.18	Clear	24	0.6	0.5	7.2	Boulders, cobble and gravel
22	22.4	5.1	0.085	6.48	Clear	4	0.1	0.9	0.4	Cobble, gravel with some silt

Table 10. Periphyton species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001.									
	Total	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
SPECIES	Volume	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**
CHLOROPHYTA									
Chlorococcales									
Oocystaceae									
Closteriopsis sp.									
Scendesmaceae									
Scenedusmus quadricauda		1.02							0.035
Ulotrichales									
Microsporaceae									
Microspora sp.		70.38	0.14	0.168		0.231			0.245
Ulotrichaceae									
Ulothrix sp.									
Chaetophorales									
Chaetophoraceae									
Stigeoclonium sp.									
Oedogoniales									
Oedogoniaceae									
Oedogonium sp.									
Siphonocladales									
Cladophoraceae									
Cladophora sp.		19.38	0.518	1.05	0.1239	0.735	4.655	53.2	2.639
Zygnematales									
Zygnemataceae									
Mougeotia sp.		5.1							
Desmidiaceae									
Closterium sp.		4.08	0.014			0.035	1.33		
Euastrum sp.							0.665		
CHRYSOPHYTA									
Bacillariophyceae									
Centrales									
Cosinodiscaeceae									
Melosira varians	2	12.75		0.063			99.75		
Pennales									

Table 10 continued.									
	Total	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
SPECIES	Volume	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**
Fragilariaceae									
Diatoma vulgare	3	5.1	0.063	0.084		0.021	7.98	1.33	0.007
Synedra ulna	3			0.021			17.29	6.65	0.126
Eunotiaceae									
Eunotia sp.	3								
Achnanthaceae									
Achnanthes lanceolata	3	8.16	0.707		0.0301	0.385	32.585	17.955	0.119
Cocconeis placentula	3	7.14	0.469	0.21	0.0161	0.175			0.042
Rhoicosphenia curvata	3		0.042	0.434	0.0021	0.098		1.33	0.042
Naviculaceae									
Amphipleura pellucida	3	1.53							
Gyrosigma sp.	3	13.26	0.056	0.021					0.014
Frustulia rhomboides	3	10.2	0.014					3.325	
Navicula sp.		36.21	0.175	0.126	0.0042	0.231	18.62	17.955	
Navicula radiosa	3	6.63		0.028			7.98	13.3	0.028
Pinnularia sp.		0.51							
Gomphonemaceae									
Gomphonema constrictum				0.014					
Gomphonema angustrum	2	12.24	0.056	0.14	0.0056	0.301	25.935	25.935	0.098
Gomphoneis herculeana		2.04					3.99		
Cymbellaceae									
Amphora ovalis	3				0.0105				
Cymbella sp.	3	7.65	0.252	0.07	0.0168	0.441		39.9	0.112
Cymbella prostrata	3	5.1						2.66	
Cymbella tumida	3	22.95					57.19	43.225	
Cymbella turgida	3					0.441			
Nitzschiaceae									
Nitzschia sp.	3	1.53	0.336	0.161		0.21			0.028
Nitzschia dissipata	3	3.57		0.028			16.625		
Nitzschia filiformis	1	1.53		0.063	0.0028		16.625	19.95	
Nitzschia linearis	3			0.07				13.3	
Nitzschia sigmoida	3			0.042					

Table 10 continued.									
	Total	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**
SPECIES	Volume	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**
Surirellaceae									
Cymatopleura solea	3			0.007					
Surirella angustra	2	0.51		0.014					
Surirella ovata	2	1.02		0.07					
CYANOPHYTA									
Oscillatoriales									
Oscillatoriaceae									
Oscillatoria sp.		6.12	0.042	0.021	0.3402	0.665	0.665		
Nostocales									
Nostocaceae									
Anabaena sp.									
***ROTIFERA**		3.06	0.028				2.66		
Ploima									
Brachionidae									
Keratella chochlearis									
Synchaetidae									
Polyarthra sp.									
Trichocercidae									
Trichocerca sp.									
Total # organisms		**268.77**	**2.912**	**2.905**	**0.5523**	**3.969**	**314.545**	**260.02**	**3.535**
Total # of taxa		**26**	**14**	**22**	**10**	**13**	**15**	**14**	**13**
Diatom taxa		20	10	19	8	9	11	13	10
Non-diatom taxa		6	4	3	2	4	4	1	3
Pollution Tolerance Index		2.76	2.97	2.73	2.87	2.85	2.44	2.65	2.841
Shannon Diversity (H') all		3.775	3.088	3.334	1.744	3.328	3.052	3.262	1.597
Shannon Diversity (H') diatoms		3.648	2.653	3.581	2.546	2.914	2.925	3.182	2.927
*Not included in analyses									

Table 10 continued.									
SPECIES	Total Volume	**Site 9**	**Site 10**	**Site 11**	**Site 12**	**Site 13**	**Site 14**	**Site 15**	
		No./mm^2	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	
CHLOROPHYTA									
Chlorococcales									
Oocystaceae									
Closteriopsis sp.								0.532	
Scendesmaceae									
Scenedusmus quadricauda									
Ulotrichales									
Microsporaceae									
Microspora sp.		0.259			1.057	7.958			
Ulotrichaceae									
Ulothrix sp.					0.056				
Chaetophorales									
Chaetophoraceae									
Stigeoclonium sp.									
Oedogoniales									
Oedogoniaceae									
Oedogonium sp.								35.644	
Siphonocladales									
Cladophoraceae									
Cladophora sp.		3.255			0.994	7.093	1.098	6.384	
Zygnematales									
Zygnemataceae									
Mougeotia sp.		0.28			0.287			2.66	
Desmidiaceae									
Closterium sp.						0.692	0.054	2.66	
Euastrum sp.									
CHRYSOPHYTA									
Bacillariophyceae									
Centrales									
Cosinodiscaeceae									
Melosira varians	2								

Table 10 continued.									
SPECIES	Total Volume	**Site 9**	**Site 10**	**Site 11**	**Site 12**	**Site 13**	**Site 14**	**Site 15**	
		No./mm^2	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	
Pennales									
Fragilariaceae									
Diatoma vulgare	3	0.049			0.42		7.695	4.256	
Synedra ulna	3	0.091	0.035	0.888	0.448	1.557	0.414	39.9	
Eunotiaceae									
Eunotia sp.	3	0.028	0.007	0.222			0.243	2.128	
Achnanthaceae									
Achnanthes lanceolata	3	2.751	0.161	82.14	1.96	60.204	4.725	65.436	
Cocconeis placentula	3			1.332	0.511		0.027		
Rhoicosphenia curvata	3					0.519			
Naviculaceae									
Amphipleura pellucida	3								
Gyrosigma sp.	3	0.028							
Frustulia rhomboides	3	0.021			0.028				
Navicula sp.		1.4	0.112	0.444	1.344	5.19	0.918	6.384	
Navicula radiosa	3								
Pinnularia sp.		0.056	0.007				0.081	5.852	
Gomphonemaceae									
Gomphonema constrictum									
Gomphonema angustrum	2		0.056	4.884	0.392	14.013	0.387	15.96	
Gomphoneis herculeana									
Cymbellaceae									
Amphora ovalis	3								
Cymbella sp.	3	1.316		0.666	0.56	42.558	0.36	112.252	
Cymbella prostrata	3								
Cymbella tumida	3								
Cymbella turgida	3		0.133						
Nitzschiaceae									
Nitzschia sp.	3	0.126	0.091		0.616	1.73	0.621	25.004	
Nitzschia dissipata	3								
Nitzschia filiformis	1								
Nitzschia linearis	3								

Table 10 continued.									
SPECIES	Total	**Site 9**	**Site 10**	**Site 11**	**Site 12**	**Site 13**	**Site 14**	**Site 15**	
	Volume	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	
Nitzschia sigmoida	3								
Surirellaceae									
Cymatopleura solea	3								
Surirella angustra	2								
Surirella ovata	2							1.064	
CYANOPHYTA									
Oscillatoriales									
Oscillatoriaceae									
Oscillatoria sp.		0.112		0.444	1.68	1.384	0.108		
Nostocales									
Nostocaceae									
Anabaena sp.						0.519			
***ROTIFERA**		0.014							
Ploima									
Brachionidae									
Keratella chochlearis									
Synchaetidae									
Polyarthra sp.									
Trichocercidae									
Trichocerca sp.									
Total # organisms		**9.786**	**0.602**	**91.02**	**10.353**	**143.417**	**16.731**	**326.116**	
Total # of taxa		**14**	**8**	**8**	**14**	**12**	**13**	**15**	
Diatom taxa		10	8	7	9	7	10	10	
Non-diatom taxa		4	0	1	5	5	3	5	
Pollution Tolerance Index		3	2.88	2.95	2.92	2.88	2.97	2.94	
Shannon Diversity (H') all		2.486	2.56	0.663	3.377	2.301	2.286	2.822	
Shannon Diversity (H') diatoms		1.926	2.56	0.621	2.752	1.776	2.001	2.389	
*Not included in analyses									

Table 10 continued.									
SPECIES	Total Volume	**Site 16**	**Site 17**	**Site 18**	**Site 19**	**Site 20**	**Site 21**	**Site 22**	
		No./mm^2	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	
CHLOROPHYTA									
Chlorococcales									
Oocystaceae									
Closteriopsis sp.									
Scendesmaceae									
Scenedusmus quadricauda						0.055	2.96	2.96	
Ulotrichales									
Microsporaceae									
Microspora sp.			0.03			0.225	4.144		
Ulotrichaceae									
Ulothrix sp.									
Chaetophorales									
Chaetophoraceae									
Stigeoclonium sp.							31.968	8.88	
Oedogoniales									
Oedogoniaceae									
Oedogonium sp.									
Siphonocladales									
Cladophoraceae									
Cladophora sp.			0.102				1.184		
Zygnematales									
Zygnemataceae									
Mougeotia sp.									
Desmidiaceae									
Closterium sp.		0.007	0.021	35					
Euastrum sp.									
CHRYSOPHYTA									
Bacillariophyceae									
Centrales									
Cosinodiscaceae									
Melosira varians	2								

Table 10 continued.									
SPECIES	Total Volume	**Site 16**	**Site 17**	**Site 18**	**Site 19**	**Site 20**	**Site 21**	**Site 22**	
		No./mm^2	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	**No./mm^2**	
Pennales									
Fragilariaceae									
Diatoma vulgare	3						8.88		
Synedra ulna	3	0.077	0.006		0.049		5.92		
Eunotiaceae									
Eunotia sp.	3							26.048	
Achnanthaceae									
Achnanthes lanceolata	3	0.189	0.18	346.62	1.008	0.555	71.04	29.6	
Cocconeis placentula	3	0.084	0.042	5.3	0.112	0.355	30.192		
Rhoicosphenia curvata	3		0.015	5.3	1.904	1.625	1.184		
Naviculaceae									
Amphipleura pellucida	3								
Gyrosigma sp.	3					0.16			
Frustulia rhomboides	3								
Navicula sp.			0.399	4.24	1.456	8.1	4.144	5.328	
Navicula radiosa	3								
Pinnularia sp.									
Gomphonemaceae									
Gomphonema constrictum									
Gomphonema angustrum	2			8.48		0.28	50.912	67.488	
Gomphoneis herculeana									
Cymbellaceae									
Amphora ovalis	3								
Cymbella sp.	3	0.007	0.078	5.3	0.035	0.655	68.08	2.368	
Cymbella prostrata	3								
Cymbella tumida	3								
Cymbella turgida	3								
Nitzschiaceae									
Nitzschia sp.	3		0.441	6.36	0.56	0.52	4.144		
Nitzschia dissipata	3								
Nitzschia filiformis	1								
Nitzschia linearis	3								

Table 10 continued.									
SPECIES	Total Volume	**Site 16** No./mm^2	**Site 17** No./mm^2	**Site 18** No./mm^2	**Site 19** No./mm^2	**Site 20** No./mm^2	**Site 21** No./mm^2	**Site 22** No./mm^2	
Nitzschia sigmoida	3								
Surirellaceae									
Cymatopleura solea	3								
Surirella angustra	2								
Surirella ovata	2		0.024			0.2			
CYANOPHYTA									
Oscillatoriales									
Oscillatoriaceae									
Oscillatoria sp.			0.018	4.24		0.25			
Nostocales									
Nostocaceae									
Anabaena sp.									
***ROTIFERA**									
Ploima									
Brachionidae									
Keratella chochlearis									
Synchaetidae									
Polyarthra sp.									
Trichocercidae									
Trichocerca sp.									
Total # organisms		**0.364**	**1.356**	**420.84**	**5.124**	**12.98**	**284.752**	**142.672**	
Total # of taxa		**5**	**12**	**9**	**7**	**12**	**13**	**7**	
Diatom taxa		4	8	7	7	9	9	5	
Non-diatom taxa		1	4	2	0	3	4	2	
Pollution Tolerance Index		3	2.97	2.98	3	2.89	2.79	2.46	
Shannon Diversity (H') all		1.672	2.613	1.106	2.091	2.075	2.808	2.07	
Shannon Diversity (H') diatoms		1.565	2.134	0.676	2.091	1.848	2.416	1.734	
*Not included in analyses									

Table 11. Chlorophyll and biomass, Indian Creek watershed, Tazewell, Virginia.

	Chla mg/m^2	Chlb mg/m^2	Chlc mg/m^2	Ash Free Dry Weight g/m^2	Biovolume mm^3/m^2	Cells No./mm^2
Site 1	23.74	5.31	2.09	4.51	1383	268.77
Site 2	18.72	1.1	2.3	2.72	16.86	2.912
Site 3	68.09	21.07	3.02	10.78	31.52	2.905
Site 4	24.62	4.46	6.03	3.45	5.16	0.5523
Site 5	52.19	19.17	2.48	3.16	26.67	3.969
Site 6	13.3	1.54	3.63	1.5	375.4	314.545
Site 7	7.36	1.16	0.78	1.45	1693.06	260.02
Site 8	6.18	1.55	0.74	1.07	78.2	3.535
Site 9	11.19	0.42	1.13	24.21	98.92	9.786
Site 10	9.81	1.62	1.11	0.69	0.13	0.602
Site 11	4.98	1.96	0.53	0.99	6.79	91.02
Site 12	33.37	9.61	4.5	8.68	39.96	10.353
Site 13	18.56	1.7	2.48	4.43	299.64	143.417
Site 14	1.15	0.77	0.93	1.01	54.73	16.731
Site 15	30.55	2.57	5.46	6.54	1308.9	326.116
Site 16	6.78	-0.14	0.84	0.21	0.38	0.364
Site 17	5.7	1.32	1.99	15.47	4.44	1.356
Site 18	49.41	2.45	9.35	2.34	1705.13	420.84
Site 19	0.91	0.13	0.39	1.02	0.71	5.124
Site 20	2.75	0.3	0.21	1.31	6.02	12.98
Site 21	24.88	1.6	2.72	3.12	78.22	284.752
Site 22	23.67	0.61	3.12	1.6	6.25	142.672

Table 12. Metrics for Virginia non-coastal benthic multimetric index (VSCI). Standard values and standardization equations.

Metrics that decrease with stress	**Standard (best value) X_{95}**	**X_{min}**	**Standardization equation X = metric value at test site.**
Total taxa	22	0	score = 100 x (X/22)
EPT taxa	11	0	score = 100 x (X/11)
% Ephemeroptera	61.3	0	score = 100 x (X/61.3)
% Plecoptera + Trichoptera - Hydropsychidae	35.6	0	score = 100 x (X/35.6)
% Scrapers	51.6	0	score = 100 x (X/51.6)
Metrics that increase with stress	**Standard (best value) X_5**	**X_5**	**Standardization equation X = metric value at test site**
% Chironomidae	0	100	score = 100 x [(100-X)/(100-0)]
% Top 2 Dominant	30.8	100	score = 100 x [(100-X)/100-30.8)]
HBI (family level)	3.2	10	score = 100 x [(10-X)/(10-3.2)]

Final Index score for a site is determined by averaging the site's 8 unitless standardized metric scores, using a maximum metric score of 100 for any metric whose individual score at a site exceeded 100.

Table 13. Percentile distribution of index (VSCI) values in the Virginia DEQ 1994-2002 reference samples.

N	461
maximum possible	100
maximum in data	88.9
95th	84.1
90th	81.7
75th	77.8
50th (median)	73.1
25th	67.7
10th	61.3
5th	56.3
minimum	25.3
standard deviation	8.4
mean	72.1

Table 14. Component Metrics and Virginia Stream Condition Index scores for samples in the Indian Creek watershed, Tazewell, Virginia.

Site	Dup #	Collection Date	Total Individuals	Total Taxa Family	Total Taxa Family R 200	EPT Taxa Family	EPT Taxa Family R 200	% Chiro-nomids	%2Dom Family	VA HBI Family	%Ephem-eroptera	% P+T-H	%Scraper	VSCI Score
1	1	25-Feb-02	172	16	16	7	7	56.4	70.3	5.3	8.1	5.2	14	43.3
2	1	26-Feb-02	816	17	9.3	4	1.7	66.3	83.6	5.7	0.2	0.1	13.7	25.7
3	1	26-Feb-02	2188	21	14.5	10	7.2	3.9	42.3	4.8	30.6	3.2	21.6	61
4	1	26-Feb-02	450	22	16.8	9	7.3	43.6	66.9	5.5	11.6	2	16	46.1
5	1	26-Feb-02	247	25	23.1	14	13	24.7	38.9	4.5	24.7	18.6	49	79
6	1	26-Feb-02	491	22	18.1	13	11.2	16.5	50.7	4.9	18.5	18.3	25.7	67.9
7	1	26-Feb-02	193	20	20	13	13	23.8	37.8	4.1	14.5	26.4	23.3	73.4
7	2	26-Feb-02	396	25	20.9	15	12.8	30.3	40.7	4.4	21.2	16.2	23.5	69.7
8	1	27-Feb-02	134	17	17	9	9	26.1	57.5	4.6	35.8	11.2	48.5	69.7
9	1	27-Feb-02	138	18	18	12	12	24.6	40.6	4	39.1	23.2	9.4	72.3
10	1	27-Feb-02	245	20	19.5	14	13.6	19.6	49	4.1	40.8	20.8	39.6	78.9
11	1	27-Feb-02	135	15	15	9	9	20.7	41.5	3.9	25.2	21.5	37.8	72.2
11	2	27-Feb-02	170	19	19	10	10	24.7	45.3	4.5	10.6	21.2	24.7	67.1
12	1	27-Feb-02	333	26	22.9	17	14.5	12.6	44.1	4.4	15.6	15.6	28.2	71.8
13	1	28-Feb-02	252	27	24.7	19	17.5	23.4	41.3	4.5	30.2	15.5	23	72.5
13	2	28-Feb-02	201	22	22	15	15	23.4	59.2	4.3	21.4	21.4	23.9	70.1
15	1	28-Feb-02	138	15	15	8	8	59.4	75.4	5.5	8.7	6.5	2.2	40
16	1	28-Feb-02	685	28	20.5	19	13.4	44.7	52.8	4.8	19.1	14	16.2	61.8
17	1	27-Feb-01	270	23	21.4	13	12.3	25.2	38.9	4.4	9.3	22.2	28.1	71.9
18	1	26-Feb-02	559	24	18.1	11	8.4	22.2	59	5.1	17.9	4.7	31.7	58.9
19	1	26-Feb-02	571	23	15.8	9	5.8	34	59.9	5	6.3	1.4	29.1	49
20	1	28-Feb-02	299	22	19.8	13	12	10.4	31.1	3.6	41.5	26.8	24.1	82.9
21	1	25-Feb-02	459	25	17.8	11	8.1	53.6	67.5	5.2	6.1	3.3	22.9	47.7
23	1	28-Feb-02	234	23	21.9	14	13.4	45.3	69.2	4.5	28.6	9	7.7	58.4

Dup = duplicate

P+T-H = %plecoptera + trichoptera - hydropsychidae

Table 15. Taxonomic list used to calculate component metrics and VSCI scores.

Family	FinalID	1	2	3	4	5	6	7	7dup	8	9	10	11	11dup	12	13	13dup	15	16	17	18	19	20	21	23
Athericidae	Atherix																				3				
Blephariceridae	Blephariceera								1												1				
Ceratopogonidae	Bezzia							1	2		1					1	1	1	1	1		4			9
Ceratopogonidae	Ceratopogon																					1			
Ceratopogonidae	Ceratopogonidae																							1	
Chironomidae	Chironomidae	97	541	85	196	61	81	46	120	35	34	48	28	42	42	59	47	82	306	68	124	194	31	246	106
Empididae	Chelifera		1			1									1	1		3	2						1
Empididae	Hemerodromia	2	3	4	1	1	2			4				1	3		1		2	2	2	12	1	1	
Psychodidae	Psychoda				1																				
Psychodidae	Psychodidae			1																					
Simuliidae	Simuliidae	24	4	41	105	15		6	30	1				35	13	1	3	1	53	5	206	1	11	52	11
Tipulidae	Antocha	3	1		4	1	2	8	10	2		6	1	1	10	5	13	4	6		1	1		16	
Tipulidae	Dicranota							3	1																
Tipulidae	Limonia				1																				
Tipulidae	Molophilus							1																	1
Tipulidae	Pedicia																					1			
Tipulidae	Pseudolimnophila				1						2				1					1		35			
Tipulidae	Tipula		4						1		2	1	1							2	3	2			
Brachycentridae	Brachycentrus																							3	
Glossosomatidae	Glossosoma					1									1	1	3				3				
Helicopsychidae	Helicopsyche	1																						5	
Hydropsychidae	Cheumatopsyche	2	54	233	12	4	130	18	9	10	1	12	8	1	54	30	15	1	19	23	6	89	11	1	
Hydropsychidae	Diplectrona							8	15						6					3		8	13		
Hydropsychidae	Hydropsyche		87	139			38	1	11			7	1		32	15	13	1	11	2	1	4	1	2	
Hydroptilidae	Hydroptila		1																						
Leptoceridae	Oecetis																							1	
Limnephilidae	Goera					1	1												1	1	2				
Limnephilidae	Hydatophylax							1			3														
Limnephilidae	Pycnopsyche							1			1									6					
Philopotamidae	Chimarra			25	3	1	12			1		6				7			9	1	2	4			
Philopotamidae	Dolophilodes							1	1			2		2	3	4	1		24		2				
Phryganeidae	Oligostomis																								1
Phryganeidae	Ptilostomis										1														
Polycentropodidae	Neureclipsis			1																					

Table 15 continued																									
Family	FinalID	1	2	3	4	5	6	7	7dup	8	9	10	11	11dup	12	13	13dup	15	16	17	18	19	20	21	23
Polycentropodidae	Polycentropus								1			1			1	1			1				1		1
Psychomyiidae	Psychomyia					1				1		2				5	9		19						
Rhyacophilidae	Rhyacophila							8	8						3	1	1			2					1
Uenoidae	Neophylax				2	32	27	6	8	7	1	12	18	6	4	5	12		3	12	7	3	5		3
Capniidae	Allocapnia					1																	25	1	
Capniidae	Capniidae					1																			
Capniidae	Paracapnia														9		1		3						5
Chloroperlidae	Chloroperlidae			2	4																		3		
Chloroperlidae	Suwallia															1									
Chloroperlidae	Sweltsa																						1		
Leuctridae	Leuctra							9	16						3			4							4
Leuctridae	Leuctridae			1								4			3	1	2		4	3			3		
Nemouridae	Amphinemura	1		41				14	13			4		1	20	2	1		5	5	1		41	2	
Nemouridae	Nemouridae						7								1	2	2	1	6						3
Nemouridae	Prostoia	7				1		7	13	3	12	7	5	21					13	25	8			2	
Perlidae	Acroneuria							3	2			5	2	1	1	3	7		4	3					
Perlodidae	Clioperla						4				3														3
Perlodidae	Diploperla															1			2						
Perlodidae	Isoperla					7	39	1	2		10					4	4	4				1	1		
Perlodidae	Perlodidae														1										
Pteronarcyidae	Pteronarcys														2	1									
Taeniopterygidae	Oemopteryx																				1				
Taeniopterygidae	Strophopteryx									3	1	8	4	5					2	2					
Taeniopterygidae	Taeniopteryx																							1	
Ameletidae	Ameletus							1	2		6	4	16	5		4	1	4	2	16	1	1	1		1
Baetidae	Baetidae			51																			4		3
Baetidae	Baetis			40					8										1						
Baetidae	Pseudocloeon																						7		
Baetiscidae	Baetisca						2					1	1			1	1			1					
Caenidae	Caenidae																							1	
Caenidae	Caenis				30		1																		
Ephemerellidae	Attenella																				3				
Ephemerellidae	Drunella							1				1													
Ephemerellidae	Ephemerella			443		13	2	2		2	4	16	13	7	7	30	27	1	45	4					2

Table 15 continued																										
Family	FinalID	1	2	3	4	5	6	7	7dup	8	9	10	11	11dup	12	13	13dup	15	16	17	18	19	20	21	23
Ephemerellidae	Ephemerellidae								16																
Ephemerellidae	Eurylophella	1	1		1		3				18	2	1	1		2						1		1	
Ephemerellidae	Serratella	1					3	3	2															3	
Ephemeridae	Ephemera	1				2	8		1		19	4	1	1	2	3			2			1			2
Heptageniidae	Epeorus						5	5	15			6	2		15	5			10		2		8		
Heptageniidae	Heptageniidae					7		1	7							7	4	1					17	3	
Heptageniidae	Leucrocuta																						6		
Heptageniidae	Stenacron				1		1					1			4						1				
Heptageniidae	Stenonema	5	1	27	16	28	56	13	19	42	6	65	1	4	10	19	9		46	4	88	4	21	14	3
Isonychiidae	Isonychia	6			2	8	4			4									4		5		26	6	
Leptophlebiidae	Leptophlebiidae				109	2	3	6	2	7						8	5	2	5	18			28	28	
Leptophlebiidae	Paraleptophlebia									7						5			1	3			1	6	
Aeshnidae	Boyeria																			1		1			
Calopterygidae	Hetaerina		1																						
Coenagrionidae	Coenagrionidae					1																			1
Coenagrionidae	Enallagma				1																				
Gomphidae	Gomphidae																							1	
Gomphidae	Stylogomphus				2			1	1		2	5			4	1					3		1	2	
Dryopidae	Helichus					1								1											
Elmidae	Dubiraphia		6	2			3				1	2									2	6		2	
Elmidae	Elmidae	1							2										5			21			
Elmidae	Gonielmis			1																				1	
Elmidae	Microcylloepus				3																				
Elmidae	Optioservus	7	80	376	30	31	22	7	15	8		9	27	24	7	17	12		36	37	61	80	5	13	
Elmidae	Oulimnius						1	13	22	1	5		1	1	48	4	8	2	4			18			12
Elmidae	Promoresia	1	1		1																			4	
Elmidae	Stenelmis	5	8	19	11	2	3															23		44	
Psephenidae	Ectopria		1	4	6									1						3					
Psephenidae	Psephenus	4		21		16	7		3	7		2	2	7	5				7	20	10	6	10	22	
Corydalidae	Nigronia								1				1		2	3	2		3		1		1	1	3
Sialidae	Sialis													1											
Pyralidae	Petrophila					1																			
Pyralidae	Pyralidae																			1					
Cambaridae	Cambaridae			2			3	1		1					1						3				

Table 15 continued

Family	FinalID	1	2	3	4	5	6	7	7dup	8	9	10	11	11dup	12	13	13dup	15	16	17	18	19	20	21	23
Asellidae	Lirceus			13																			8		
Gammaridae	Gammarus		1	482																					
Ancylidae	Ancylidae																				2				
Ancylidae	Ferrissia				1	3																1			
Lymnaeidae	Fossaria																					1			
Physidae	Physa		5				1															3			
Pleuroceridae	Goniobasis	1	10	22	1	1																		1	
Valvatidae	Valvata																							1	
Corbiculidae	Corbicula	1	1			2																1		1	
Oligochaeta	Oligochaeta	1	3	3	10		16		3	2	4	2	2	2				22	3	16	4	11	2	3	2
Turbellaria	Turbellaria		1		1		1															3			1

Note that the following taxa were excluded from the table: organisms that could only be identified to the Order level, Collembola, Copepoda, Hydracarina, Nematoda, and Nemertea.

Table 16. Physical/Chemical Characteristics of Stream Reach, Indian Creek, Tazewell, Virginia.

Site	Stream Name	Mean Stream Width (m)	Mean Velocity (ft/sec)	Temp	Conductivity (uS/cm)	Dissolved Oxygen (mg/l)	pH
1	Indian Creek	6.9	1.43	8.8	248	13.4	8.57
2	Lowe Branch	1.3	1.12	8.9	515	11.6	7.97
3	Lowe Branch	1.7	0.88	8.1	503	10.6	7.67
4	NNT to Lowe Branch	3.5	0.24*	7.7	395	12.3	7.69
5	Indian Creek	5.5	1.56	5.9	173	14.2	8.02
6	Laurel Fork	1.1	0.96	9.0	176	9.5	7.44
7	Laurel Fork	2.7	0.38	6.6	139	11.4	6.95
8	Indian Creek	6.9	1.25	1.3	137	12.2	7.16
9	Greasy Creek	2.7	1.13	2.4	135	10.2	7.35
10	Greasy Creek	4.5	0.75	0.8	112	11.1	6.7
11	Indian Creek	4.4	0.94	1.8	145	11.1	6.64
12	Jackson Fork	3.3	0.93	0.4	185	11.4	6.77
13	Indian Creek	3.4	0.8	1.0	110	12.6	6.1
15	South Branch of Indian Creek	2.8	1.35	6.9	90	9.0	6.57
16	Indian Creek	4	0.77	1.9	153	12.2	6.32
17	Panther Branch	1.8	0.72	4.4	170	10.4	7.06
18	Indian Creek	6.4	1.04	9.0	186	12.4	7.06
19	Coal Branch	1.2	0.42	8.6	191	13.8	8.2
20	Raven Nest Branch	2.4	0.62	1.9	244	13.0	6.45
21	Indian Creek	9.6	0.91	8.2	248	13.0	8.32
23	North Branch of Indian Creek	4	0.56	1.7	63	11.9	7.09

* Difficult to obtain accurate velocity reading due to large substrate.

Table 17. Habitat assessment scores (individual parameter scores that are marginal or poor are bolded. Habitat parameters are listed at end of table)

Site	1	2	3	4	5	6	7	8	9	10	Total
1	15	18	14	16	16	16	16	9 9	9 6	**8** **2**	154
2	15	14	**10**	13	16	13	17	6 6	**5** **5**	**2** **2**	124
3	15	14	**10**	15	16	**8**	17	9 9	**2** **3**	**2** **1**	121
4	**10**	16	**11**	16	16	16	16	6 6	**5** **5**	2 9	134
5	17	16	**10**	18	16	16	18	9 9	10 9	9 5	162
6	13	18	**10**	17	16	13	16	9 6	**4** **2**	**1** **2**	127
7	17	18	**10**	19	16	18	18	10 10	10 9	10 6	171
8	18	19	15	19	16	15	18	9 9	**6** **3**	**6** **2**	155
9	**6**	**6**	14	**6**	16	15	**9**	8 8	6 6	**3** **4**	107
10	17	13	**10**	18	16	18	18	9 9	9 9	7 9	162
11	14	16	**10**	17	16	15	17	8 8	6 9	**2** **8**	146
12	16	15	**10**	18	16	14	18	9 9	9 6	9 2	151
13	15	15	**10**	18	16	11	18	9 9	6 9	2 9	147
15	11	**8**	**10**	**6**	16	11	**6**	7 5	6 6	**2** **2**	96
16	19	15	**10**	18	16	15	18	9 9	9 6	**3** **4**	151
17	16	13	**10**	11	16	13	18	9 7	6 9	**1** **8**	137
18	15	17	**10**	16	16	14	17	9 6	9 4	**9** **1**	143
19	11	11	**10**	11	16	17	11	6 7	3 9	2 9	123
20	13	13	**10**	14	16	16	17	7 5	**2** **2**	**6** **3**	124
21	15	16	**10**	15	16	15	18	9 9	9 6	**8** **2**	148
23	16	14	**10**	12	16	15	16	7 7	9 9	10 8	149

Habitat Parameters:

1=Epifaunal Substrate/Available Cover
2=Embeddedness
3=Velocity/Depth Regime
4=Sediment Deposition
5=Channel Flow Status
6=Channel Alteration
7=Frequency of Riffles (or bends)
8=Bank Stability (score both left and right banks)
9=Vegetative Protection (score both left and right banks)
10=Riparian Vegetative Width Zones (both left and right bank)

Total = sum of parameters 1-10 (the highest possible score is 200).

Note that the individual ranges for the scores are as follows:
20-16 Optimal 15-11 Suboptimal 10-6 Marginal 5-0 Poor

Table 18. Total IBI scores, integrity classes, and the attributes of those classes (Karr, et. aL, 1986).

IBI Score	Integrity Class	Attributes
58-60	Excellent	Comparable to the best situation without human disturbance; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with a full array of age (size) classes; balanced trophic structure.
48-52	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundance or size distributions; trophic structure shows some signs of stress.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure (e.g., increasing frequency of omnivores and green sunfish or other tolerant species); older age classes of top predators may be rare.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; hybrids and diseased fish often present.
12-22	Very poor	Few fish present, mostly introduced or tolerant forms; hybrids common; disease, parasites, fin damage, and other anomalies regular.

Table 19. Fish species collected in the Indian Creek watershed, Tazewell, Virginia, the week of September 10, 2001.

Common name	Scientific name	Tolerance [a]	Trophic guild[b]	Reproductive guild[c]	Headwater habitat[d]
Banded darter	Etheostoma zonale		SP	L	R
Bigeye chub	Hybopsis amblops	HI	SP	L	P
Black redhorse	Moxostoma duquesnei	IN	IN	L	P
Blacknose dace	Rhinichthys atratulus		IN	L	
Bluntnose minnow	Pimephales notatus		OM		P
Brown trout*	Salmo trutta		TC		
Central stoneroller	Campostoma anomalum		OM		
Clinch sculpin	Cottus sp.		IN		R
Creek chub	Semotilus atromaculatus	TO	IN		P
Fantail darter	Etheostoma flabellare	IN	SP		R
Fathead minnow*	Pimephales promelas		OM		P
Greenside darter	Etheostoma blennioides		SP	L	R
Largemouth bass	Micropterus salmoides		TC		P
Mirror shiner	Notropis spectrunculus		SP	L	P
Mountain brook lampey	Ichthyomyzon greeleyi	HI	HB		P
Mountain shiner	Lythrurus lirus	HI	SP	L	P
Northern hog sucker	Hypentelium nigricans	HI	IN	L	
Northern studfish	Fundulus catenatus	HI	SP	L	R
Rainbow trout*	Onchorhynchus mykiss		IN		
Redbelly dace	Phoxinus sp., cf. saylori	HI			P
Redbreast sunfish*	Lepomis auritus		IN		
Redline darter	Etheostoma rufilineatum		SP	L	R
River chub	Nocomis micropogon		OM		P
Rock bass	Ambloplites rupestris	IN	TC		P
Rosyside dace	Clinostomus funduloides	IN	SP	L	P
Sawfin shiner	Notropis (undescribed)	HI	SP	L	R
Smallmouth bass	Micropterus dolomieu		TC		P
Snubnose darter	Etheostoma simoterum		SP	L	R
Speckled darter	Etheostoma stigmaeum	IN	SP	L	P
Striped shiner	Luxilus chrysocephalus	TO	OM	L	P
Telescope shiner	Notropis telescopus	IN	SP	L	P
Tennessee shiner	Notropis leuciodus	HI	SP	L	P
Warpaint shiner	Luxilus coccogenis	HI	SP	L	P
White sucker	Catostomus commersoni	TO	OM	L	P
Whitetail shiner	Cyprinella galactura		IN		P
Yellow bullhead	Ameiurus natalis	TO	OM		P

*introduced species

[a]IN - intolerant, TO - tolerant, HI - headwater intolerant only

[b]IN - insectivore, OM - omnivore, SP - specialist insectivore, TC - piscivore, HB - herbivore

[cL] - simple lithophils

[d]R - riffle, P - pool

Table 20. Fish Sampling Sites--Indian Creek Watershed, Tazewell County, Virginia.

Site	Stream	Stream Drainage (sq mi)	IBI	IBI Rating	Total # Individuals	# Species
19	Coal Branch	0.66	46	Fair/good	125	9
17	Panther Creek	0.87	38	Poor/fair	80	2
20	Raven Nest	1.18	40	Fair	53	4
3	Lowe Branch	1.44	34	Poor	123	4
4	unnamed trib	1.50	40	Fair	179	7
9	Greasy Creek	1.89	48	Good	207	6
2	Lowe Branch	2.24	36	Poor/fair	92	4
15	South Branch	2.33	38	Poor/fair	77	5
12	Jackson Creek	2.74	38	Poor/fair	183	5
7	Laurel Fork	3.07	42	Fair	234	9
14	North Branch	3.43	44	Fair	218	6
6	Laurel Fork	3.82	50	Good	803	15
10	Greasy Creek	4.49	44	Fair	176	6
13	Indian Creek	6.57	42	Fair	365	7
16	Indian Creek	9.97	52	Good	238	18
11	Indian Creek	10.99	46	Fair/good	348	18
8	Indian Creek	16.10	50	Good	713	20
18	Indian Creek	19.42	48	Good	538	22
5	Indian Creek	28.62	48	Good	740	22
1	Indian Creek	32.80	42	Fair	826	28
21	Indian Creek			NS	NS	NS
22	North Branch	2.10	50	Good	187	8

NS - not sampled

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

Sediments	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
priority pollutants - semivolatiles (ug/kg)											
acenaphthene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
acenaphthylene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
anthracene	550U	130J	480U	590U	460U	32J	460U	480U	490U	440U	480U
benzidine	4500U	4300U	4000U	4800U	3800U	4000U	3800U	3900U	4000U	3600U	3900U
benzo(a)anthracene	550U	330J	480U	590U	460U	170J	460U	480U	490U	440U	480U
benzo(a)pyrene	550U	260J	480U	590U	460U	170J	460U	480U	490U	440U	480U
benzo(b)fluoranthene	550U	250J	480U	590U	460U	240J	460U	480U	490U	440U	480U
benzo(g,h,I)perylene	550U	170J	480U	590U	460U	110J	460U	480U	490U	440U	480U
benzo(k)fluoranthene	550U	270J	480U	590U	460U	120J	460U	480U	490U	440U	480U
bis(2-chloroethoxy)methane	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
bis(2-chloroethyl)ether	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,2'-oxybis(1-chloropropane) [bis(2-chloroisopropyl) ether]	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
bis(2-ethylhexyl)phthalate	550U	180J	480U	590U	460U	480U	460U	480U	490U	440U	480U
4-bromophenylphenyl ether	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
butylbenzylphthalate	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2-chloronaphthalene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
4-chlorophenylphenyl ether	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
chrysene	550U	380J	480U	590U	460U	230J	460U	480U	490U	440U	480U
dibenzo(a,h)anthracene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
1,2-dichlorobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
1,3-dichlorobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
1,4-dichlorobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
3,3'-dichlorobenzidine	1100U	1000U	970U	1200U	920U	970J	920U	960U	980U	890U	960U
diethylphthalate	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
dimethylphthalate	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
di-n-butylphthalate	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,4-dinitrotoluene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,6-dinitrotoluene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
di-n-octylphthalate	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
1,2-diphenylhydrazine	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
fluoranthene	550U	830	480U	590U	460U	520	460U	480U	490U	440U	480U
fluorene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
hexachlorobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
hexachlorobutadiene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
hexachlorocyclopentadiene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
hexachlorethane	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
indeno(1,2,3-cd)pyrene	550U	140J	480U	590U	460U	480U	460U	480U	490U	440U	480U
isophorone	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
naphthalene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U

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nitrobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

SVOC cont.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
n-nitrosodimethylamine	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
n-nitrosodi-n-propylamine	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
n-nitrosodiphenylamine	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
phenanthrene	550U	390J	480U	590U	460U	290J	460U	480U	490U	440U	480U
pyrene	550U	680	480U	590U	460U	420J	460U	480U	490U	440U	480U
1,2,4-trichlorobenzene	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2-chlorophenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,4-dichlorophenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,4-dimethylphenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
4,6-dinitro-2-methylphenol	2800U	2700U	2500U	3000U	2400U	2500U	2400U	2500U	2500U	2300U	2500U
2,4-dinitrophenol	2800U	2700U	2500U	3000U	2400U	2500U	2400U	2500U	2500U	2300U	2500U
2-nitrophenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
4-nitrophenol	2800U	2700U	2500U	3000U	2400U	2500U	2400U	2500U	2500U	2300U	2500U
4-chloro-3-methylphenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
pentachlorophenol	2800U	2700U	2500U	3000U	2400U	2500U	2400U	2500U	2500U	2300U	2500U
phenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
2,4,6-trichlorophenol	550U	520U	480U	590U	460U	480U	460U	480U	490U	440U	480U
Chlorinated Pesticides (ug/kg)											
aldrin	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
alpha-BHC	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
beta-BHC	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
gamma_BHC (lindane)	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
delta-BHC	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
chlordane	28U	27U	25U	30U	24U	25U	24U	25U	25U	23U	25U
4,4'-DDD	1.6J	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
4,4'-DDE	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
4,4'-DDT	2.3J	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
dieldrin	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
endosulfan I	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
endosulfan II	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
endosulfan sulfate	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
endrin	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
endrin aldehyde	5.5U	5.2U	4.8U	5.9U	4.6U	4.8U	4.6U	4.8U	4.9U	4.4U	4.8U
heptachlor	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
heptachlor epoxide	2.8U	2.7U	2.5U	3.0U	2.4U	2.5U	2.4U	2.5U	2.5U	2.3U	2.5U
toxaphene	280U	270U	250U	300U	240U	250U	240U	250U	250U	230U	250U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
PCBs (ug/kg)											
aroclor-1016	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
aroclor-1221	110U	110U	98U	120U	93U	98U	93U	98U	100U	90U	97U
aroclor-1232	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
aroclor-1242	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
aroclor-1248	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
aroclor-1254	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
aroclor-1260	55U	52U	48U	59U	46U	48U	46U	48U	49U	44U	48U
Priority Pollutant - Metals (mg/kg)											
antimony	0.76BN	0.67BN	0.68BN	1.0BN	2.5UN	2.7UN	0.65BN	2.6UN	0.70BN	2.5UN	2.9UN
arsenic	5.6	11	9.7	23	5	2	3.9	3.7	6.6	3.6	4.4
beryllium	0.86	1.1	1.3	1.2	0.54	0.37	0.52	0.51	1.1	0.65	1
chromium	8.5	21	32	76	5.2	3	4	3.7	7.7	5.7	5.2
copper	9.7	15	10	**260**	3.8	2.8	4.5	3.4	11	8.5	6.7
lead	9.7	15	16	26	7.4	3.6B	5.8B	5.0B	14	6.5	8.3
nickel	11	20	18	18	6.3B	4.0B	6.5	6.0B	13	9.4	8.9
selenium	1.5U	1.4U	1.5U	1.8U	1.3U	1.3U	1.3U	1.3U	1.5U	1.2U	1.4U
silver	1.5U	1.4U	1.5U	1.8U	1.3U	1.3U	1.3U	1.3U	1.5U	1.2U	1.4U
thallium	1.5U	6.7B	1.4B	1.8U	1.3U	1.3U	1.3	1.3B	1.5U	2.6	1.4U
zinc	47	88	84	55	30	20	25	27E	76E	43E	40E
cadmium	0.11B	0.14B	0.17B	0.26B	0.038B	0.046B	0.058B	0.029B	0.033B	0.048B	0.079BW
mercury	0.013B	0.017B	0.018B	0.021B	0.028B	0.0076B	0.0065B	0.026U	0.013B	0.023U	0.026U
Phenolics, Total (mg/kg)	1.7U	1.6U	1.5U	1.8U	1.4U	1.5U	1.4U	1.4U	1.5U	1.4U	1.4U
Cyanide, Total (mg/kg)	1.6U	1.6U	1.4U	1.8U	1.3U	1.5U	1.4U	1.4U	1.5U	1.3U	1.4U
Total Organic Carbon (mg/kg)	9600	12000	29000	26000	5300	8900	8200	6700	9100	9000	9000
Volatile Organic Compounds (ug/kg)											
acrolein	270U	210U	260U	320U	150U	160U	170U	280U	290U	290U	450U
acrylonitrile	270U	210U	260U	320U	150U	160U	170U	280U	290U	290U	450U
benzene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
bromoform	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
carbon tetrachloride	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
chlorobenzene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
dibromochloromethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
chlorethane	27U	21U	27U	32U	15U	16U	17U	28U	29U	29U	45U
2-chloroethylvinyl ether	130UJ	110UJ	130UJ	160UJ	75UJ	82UJ	87UJ	140UJ	140UJ	150UJ	230UJ
chloroform	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
VOC's cont.											
dichlorobromomethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,1-dichloroethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,2-dichloroethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,1-dichloroethene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,2-dichloropropane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,3-dichloropropylene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
ethylbenzene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
bromomethane	27U	21U	26U	32U	15U	16U	17U	28U	29U	29U	45U
chloromethane	27U	21U	26U	32U	15U	16U	17U	28U	29U	29U	45U
methylene chloride	13U	11U	13U	16U	7.5U	8.2U	3.4J	14U	14U	15U	23U
1,1,2,2-tetrachloroethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
tetrachloroethene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
toluene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
trans-1,2-dichloroethene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,1,1-trichloroethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
1,1,2-trichloroethane	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
trichlorethene	13U	11U	13U	16U	7.5U	8.2U	8.7U	14U	14U	15U	23U
vinyl chloride	27U	21U	26U	32U	15U	16U	17U	28U	29U	29U	45U
Acid Volatile Sulfide (mg/kg)	28	96	37	400	14U	15U	14U	15U	15U	14U	15U
Acid Volatile Sulfide Extractable Metals (mg/kg)											
cadmium	0.084B	0.14	0.11	0.23	0.033B	0.037B	0.040B	0.051B	0.062B	0.053B	0.049B
copper	2.1	4.2	2.4	2.3	1.2	1.3	2.1	1.4	2.6	1.1	1.7
nickel	1.2	2.2	1.6	1.2	1	1.1	1.2	1.4	1.1	1	1.6
zinc	9.6E	24E	21E	8.7E	7.4E	8.5E	6.7E	7.5	10	11	8
lead	4.2	8.6	10	13	3.4	2.5	2.2	2.5	4.6	2.1	2.8
Grain Size											
%gravel	26.1	24.2	19.8	50.3	44.6	0	0	0.2	2.4	7.4	1.5
%sand	66.8	65.1	47.4	40.4	47.7	95.7	89.1	73	89.1	91.7	46.1
%silt	6	10.3	26.3	7.2	6.8	3.2	10.1	26.2	7.7	0.8	51.6
%clay	1.1	0.4	6.5	2.1	0.9	1.1	0.8	0.6	0.8	0.1	0.8

B (inorganic) - reported value is less than the Project Reporting Limit but greater than or equal to the Method Detection Limit
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the RL and greater than the MDL
U - compound was analyzed for but not detected
W - due to matrix interference the furnace analytical spike for Site 11 was not within acceptable limits for cadmium, and result was flagged with "W"

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
priority pollutants - SVOC (ug/kg)											
acenaphthene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
acenaphthylene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
anthracene	530U	460U	560U	890U	440U	540U	470U	48J	610U	470U	870U
benzidine	4400U	3800U	4600U	7300U	3600U	4400U	3800U	4000U	5000U	3800U	7100U
benzo(a)anthracene	530U	460U	560U	890U	440U	540U	470U	52J	610U	470U	870U
benzo(a)pyrene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
benzo(b)fluoranthene	530U	460U	560U	890U	440U	540U	470U	42J	610U	470U	870U
benzo(g,h,I)perylene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
benzo(k)fluoranthene	530U	460U	560U	890U	440U	540U	470U	17J	610U	470U	870U
bis(2-chloroethoxy)methane	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
bis(2-chloroethyl)ether	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2,2'-oxybis(1-chloropropane) [bis(2-chloroisopropyl) ether]	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
bis(2-ethylhexyl)phthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
4-bromophenylphenyl ether	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
butylbenzylphthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2-chloronaphthalene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
4-chlorophenylphenyl ether	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
chrysene	530U	460U	560U	890U	440U	540U	470U	51J	610U	470U	870U
dibenzo(a,h)anthracene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
1,2-dichlorobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
1,3-dichlorobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
1,4-dichlorobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
3,3'-dichlorobenzidine	1100U	920U	1100U	1800U	890U	1100U	940U	970U	1200U	940U	1700U
diethylphthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
dimethylphthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
di-n-butylphthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	41J	870U
2,4-dinitrotoluene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2,6-dinitrotoluene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
di-n-octylphthalate	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
1,2-diphenylhydrazine	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
fluoranthene	530U	460U	560U	890U	440U	540U	470U	140J	610U	470U	870U
fluorene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
hexachlorobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
hexachlorobutadiene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
hexachlorocyclopentadiene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
hexachlorethane	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
indeno(1,2,3-cd)pyrene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
isophorone	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
naphthalene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U

nitrobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

SVOC cont.	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
n-nitrosodimethylamine	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
n-nitrosodi-n-propylamine	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
n-nitrosodiphenylamine	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
phenanthrene	530U	460U	560U	890U	440U	540U	470U	150J	610U	470U	870U
pyrene	530U	460U	560U	890U	440U	540U	470U	99J	610U	470U	870U
1,2,4-trichlorobenzene	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2-chlorophenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2,4-dichlorophenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2,4-dimethylphenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
4,6-dinitro-2-methylphenol	2700U	2400U	2900U	4600U	2300U	2800U	2400U	2500U	3100U	2400U	4500U
2,4-dinitrophenol	2700U	2400U	2900U	4600U	2300U	2800U	2400U	2500U	3100U	2400U	4500U
2-nitrophenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
4-nitrophenol	2700U	2400U	2900U	4600U	2300U	2800U	2400U	2500U	3100U	2400U	4500U
4-chloro-3-methylphenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
pentachlorophenol	2700U	2400U	2900U	4600U	2300U	2800U	2400U	2500U	3100U	2400U	4500U
phenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
2,4,6-trichlorophenol	530U	460U	560U	890U	440U	540U	470U	480U	610U	470U	870U
Chlorinated Pesticides (ug/kg)											
aldrin	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
alpha-BHC	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
beta-BHC	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
gamma_BHC (lindane)	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
delta-BHC	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
chlordane	27U	24U	29U	46U	23U	28U	24U	25U	31U	24U	45U
4,4'-DDD	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
4,4'-DDE	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
4,4'-DDT	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
dieldrin	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
endosulfan I	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
endosulfan II	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
endosulfan sulfate	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
endrin	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
endrin aldehyde	5.3U	4.6U	5.6U	8.9U	4.4U	5.4U	4.7U	4.8U	6.1U	4.7U	8.7U
heptachlor	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
heptachlor epoxide	2.7U	2.4U	2.9U	4.6U	2.3U	2.8U	2.4U	2.5U	3.1U	2.4U	4.5U
toxaphene	270U	240U	290U	460U	230U	280U	240U	250U	310U	240U	450U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
PCBs (ug/kg)											
aroclor-1016	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
aroclor-1221	110U	93U	110U	180U	90U	110U	96U	98U	120U	96U	180U
aroclor-1232	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
aroclor-1242	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
aroclor-1248	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
aroclor-1254	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
aroclor-1260	53U	46U	56U	89U	44U	54U	47U	48U	61U	47U	87U
Priority Pollutant - Metals (mg/kg)											
antimony	2.9UN	0.80BN	3.1UN	5.4UN	2.3UN	0.76BN	2.4UN	2.5UN	3.4UN	0.61BN	1.3BN
arsenic	3	3	3.7	5.2	5.9	9.3	1.9	9.3	7	10	3.5
beryllium	0.6	0.64	0.72	1.9	0.62	1	0.35	0.5	0.56	0.67	1.4
chromium	3.6	4.5	5	12	5.3	11	3.2	7.7	9.1	11	9
copper	15	4.3	5	21	5.1	13	2.6	3.6	11	7.9	12
lead	6.6B	5.0B	5.6B	16	5.8	16	4.8B	6.2	12	11	11B
nickel	6.8B	9	7.9	21	8.1	14	4.9B	7.7	13	13	15
selenium	1.5U	1.3U	1.5U	2.7U	1.1U	1.5U	1.2U	1.2U	1.7U	1.3U	2.4U
silver	1.5U	1.3U	1.5U	2.7U	1.1U	1.5U	1.2U	1.2U	1.7U	1.3U	2.4U
thallium	2.9	1.2B	1.5U	2.4B	1.5	2	1.0B	1.2U	1.2B	1.3U	2.4U
zinc	30E	30	28	69	30E	76E	22E	33E	71E	49	46
cadmium	0.076B	0.044B	0.060B	0.19B	0.041B	0.048B	0.032B	0.044B	0.12B	0.062B	0.15B
mercury	0.018B	0.025U	0.022B	0.038B	0.0072B	0.010B	0.029U	0.0099B	0.027B	0.0084B	0.038B
Phenolics, Total	1.6U	1.4U	1.7U	2.7U	1.4U	1.6U	1.4U	1.5U	1.8U	1.4U	2.6U
Cyanide, Total	1.6U	1.3U	1.8U	2.7U	1.3U	1.6U	1.4U	1.5U	1.8U	1.4U	2.6U
Total Organic Carbon	21000	6800	15000	50000	11000	12000	4300	8000	48000	3700	50000
Volatile Organic Compounds (ug/kg)											
acrolein	580U	150U	190U	420U	220U	410U	170U	230U	370U	600U	470U
acrylonitrile	580U	150U	190U	420U	220U	410U	170U	230U	370U	600U	470U
benzene	29U	7.4U	9.6U	21U	11U	9.6J	8.7U	11U	18U	30U	23U
bromoform	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
carbon tetrachloride	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
chlorobenzene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
dibromochloromethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
chlorethane	58U	15U	19UJ	42U	22U	41U	17U	23U	37U	60U	47U
2-chloroethylvinyl ether	290UJ	74UJ	96U	210UJ	110UJ	200UJ	87UJ	110UJ	180UJ	300UJ	230UJ
chloroform	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U

Analytical results of sediments sampled in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
VOCs cont.											
dichlorobromomethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,1-dichloroethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,2-dichloroethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,1-dichloroethene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,2-dichloropropane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,3-dichloropropylene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
ethylbenzene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
bromomethane	58U	15U	19UJ	42U	22U	41U	17U	23U	37U	60U	47U
chloromethane	58U	15U	19UJ	42U	22U	41U	17U	23U	37U	60U	47U
methylene chloride	29U	2.2J	3.5J	8.2J	11U	20U	8.7U	11U	18U	30U	7.6J
1,1,2,2-tetrachloroethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
tetrachloroethene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
toluene	29U	7.4U	9.6U	21U	11U	26	8.7U	11U	18U	30U	23U
trans-1,2-dichloroethene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,1,1-trichloroethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
1,1,2-trichloroethane	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
trichlorethene	29U	7.4U	9.6U	21U	11U	20U	8.7U	11U	18U	30U	23U
vinyl chloride	58U	15U	19UJ	42U	22U	41U	17U	23U	37U	60U	47U
Acid Volatile Sulfide (mg/kg)	16U	14U	18	27U	14U	16U	14U	15U	57	14U	28
Acid Volatile Sulfide Extractable Metals (mg/kg)											
cadmium	0.059B	0.056B	0.12U	0.16B	0.058B	0.096B	0.040B	0.056B	0.16	0.049B	0.16B
copper	10	1.4	0.028B	7.4	2	3.2	1.1	1.5	5.5	3.9	6.2
nickel	1.7	2.2	0.057B	3.7	1.4	1.5	0.87	1	2.8	1.6	3.3
zinc	9.6	7.9E	0.18BE	11E	6.4	16	7.6	8.8	30	12E	12E
lead	2.5	2.5	0.12U	7.7	2.7	4	2.3	2.6	8.2	5.4	7.6
Grain Size											
%gravel	0	10.9	0	0	16.3	15.1	0	0	34.1	10.9	0
%sand	95.6	82.1	90.6	17.9	78.3	73.1	98	88.6	54.6	85.1	72
%silt	2	5.7	8.1	71	3.9	9.8	1.2	7.2	9.2	2.6	23.9
%clay	2.4	1.3	1.3	11.1	1.5	2	0.8	4.2	2.1	1.4	4.1

B (inorganic) - reported value is less than the Project Reporting Limit but greater than or equal to the Method Detection Limit
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the RL and greater than the MDL
U - compound was analyzed for but not detected
W - due to matrix interference the furnace analytical spike for Site 11 was not within acceptable limits for cadmium, and result was flagged with "W"

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
Total Dissolved Solids (mg/l)	190	300	320	270	190	160	140	130	190	150	130
Suspended Solids (mg/l)	5.0U	5.0U	5.0U	5.0U	5.0U	7	8	5.0U	8	5.0U	5.0U
Hardness, Carbonate (mg/l)	150	250	270	210	230	94	75	79	99	98	98
priority pollutants - semivolatiles (ug/l)											
acenaphthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
acenaphthylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzidine	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U
benzo(a)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(a)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(b)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(g,h,I)perylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(k)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethoxy)methane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethyl)ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,2'-oxybis(1-chloropropane) [bis(2-chloroisopropyl) ether]	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U	0.70J	0.91J	0.90J	10U
4-bromophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
butylbenzylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chloronaphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-chlorophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chrysene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dibenzo(a,h)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,3-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,4-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
3,3'-dichlorobenzidine	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
diethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dimethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-butylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,6-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-octylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-diphenylhydrazine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluorene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

SVOC cont.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
hexachlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorobutadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorocyclopentadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorethane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
indeno(1,2,3-cd)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
isophorone	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
naphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
nitrobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodimethylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodi-n-propylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodiphenylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
phenanthrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2,4-trichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dimethylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4,6-dinitro-2-methylphenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2,4-dinitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2-nitrophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-nitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
4-chloro-3-methylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pentachlorophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
phenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4,6-trichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Chlorinated Pesticides (ug/l)		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
aldrin	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
gamma_BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
4,4'-DDD	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDE	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDT	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
dieldrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan I	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
endosulfan II	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan sulfate	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin aldehyde	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
heptachlor	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
heptachlor epoxide	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
toxaphene	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
PCBs (ug/l)											
aroclor-1016	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1221	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
aroclor-1232	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1242	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1248	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1254	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1260	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Priority Pollutant - Metals (ug/l)											
antimony	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	3.5B	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
cadmium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	3.0U	0.83B	3.0U	3.0U	3.0U	3.0U	1.2B	0.92B	0.85B	3.0U
copper	3.1B	3.1B	3.7B	3.3B	3.2B	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
lead	10U	10U	10U	10U	10U	10U	10U	10U	10U	2.6B	10U
nickel	5.0U	5.0U	2.3B	5.0U	1.7B	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
selenium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
silver	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
thallium	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
zinc	10U	3.1B	3.2B	10U	3.2B	2.6B	1.4B	10U	0.83B	4.9B	10U
mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Phenolics, Total (mg/l)	0.014B	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.0074B	0.0077B	0.010U
Nitrate + Nitrite-N (mg/l)	0.23	0.75	0.82	0.46	0.34	0.084	0.16	0.088	0.057	0.11	0.092
ammonia as N (mg/l)	0.030U	0.022B	0.030U	0.030U	0.030U	0.030U	0.030U	0.030U	0.063	0.030U	0.030U
Total Phosphorus (mg/l)	0.10U	0.068B	0.052B	0.10U	0.10U	0.065B	0.055B	0.10U	0.061B	0.057B	0.049B
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.26	0.20U	0.20U	0.20U	0.19B	0.13B	0.20U	0.20U	0.20U	0.20U
Total Organic Carbon (mg/l)	1.4	1.3	0.65B	1.5	1.6	2.3	1.8	1.3	0.90B	1.3	1.4

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

VOCs (ug/l)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
acrolein	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Total Dissolved Solids (mg/l)	160	110	45	86	120	220	160	160	220	190	50
Suspended Solids (mg/l)	5.0U	22	9	32	22	5.0U	5.0U	5.0U	75	5.0U	95
Hardness, Carbonate (mg/l)	87	54	43	53	75	120	97	120	170	150	50
PP - SVOC (ug/l)											
acenaphthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
acenaphthylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzidine	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U
benzo(a)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(a)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(b)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(g,h,I)perylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(k)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethoxy)methane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethyl)ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,2'-oxybis(1-chloropropane)	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-bromophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
butylbenzylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chloronaphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-chlorophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chrysene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dibenzo(a,h)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,3-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,4-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
3,3'-dichlorobenzidine	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
diethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dimethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-butylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,6-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-octylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-diphenylhydrazine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluorene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

SVOC cont.	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
hexachlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorobutadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorocyclopentadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorethane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
indeno(1,2,3-cd)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
isophorone	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
naphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
nitrobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodimethylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodi-n-propylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodiphenylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
phenanthrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2,4-trichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dimethylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4,6-dinitro-2-methylphenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2,4-dinitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2-nitrophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-nitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
4-chloro-3-methylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pentachlorophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
phenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4,6-trichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Chlorinated Pesticides (ug/l)	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
aldrin	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
gamma_BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	
4,4'-DDD	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
4,4'-DDE	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
4,4'-DDT	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
dieldrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
endosulfan I	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
endosulfan II	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
endosulfan sulfate	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
endrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
endrin aldehyde	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	
heptachlor	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
heptachlor epoxide	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	
toxaphene	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
PCBs (ug/l)											
aroclor-1016	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1221	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
aroclor-1232	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1242	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1248	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1254	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1260	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
PP - Metals (ug/l)											
antimony	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
cadmium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	3.0U	3.0U	3.0U	0.75B	1.9B	3.0U	3.0U	0.83B	3.0U	0.86B
copper	5.0U	5.0U	8.5	5.0U	5.0U	3.3B	5.0U	0.61B	0.81B	3.6B	5.0U
lead	10U	10U	10U	10U	10U	3.6B	10U	10U	10U	10U	10U
nickel	5.0U	1.4B	1.7B	2.6B	5.0U	1.7B	5.0U	5.0U	5.0U	1.4B	1.4B
selenium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
silver	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
thallium	10U	10U	10U	10U	10U	10U	10U	10U	10U	6.7B	10U
zinc	10U	1.4B	70	3.6B	2.0B	14	10U	0.82B	2.0B	10U	3.9B
mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.11B
Phenolics, Total (mg/l)	0.050U	0.050U	0.050U	0.050U	0.050U	0.012B	0.050U	0.022B	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Nitrate + Nitrite-N (mg/l)	0.1	0.14	0.19	0.050U	0.092	0.14	0.11	0.13	0.48	0.14	0.043B
ammonia as N (mg/l)	0.030U	0.030U	0.030U	0.11	0.030U	0.030U	0.030U	0.021B	0.030U	0.030U	0.23
Total Phosphorus (mg/l)	0.10U	0.073B	0.037B	0.067B	0.10U	0.13	0.043B	0.067B	0.14	0.041B	0.098B
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.15B	0.25	0.25	0.20U	0.83	0.20U	0.25	1	0.20U	0.65
Total Organic Carbon (mg/l)	1.3	2.1	3.3	2.6	2	1.3	1.5	2.6	1.6	2	3.2

Analytical results of surface water collected in the Indian Creek watershed, Tazewell County, Virginia, September 2001

VOCs (ug/l)	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
acrolein	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	0.19J	1.0U	0.16J	1.0U	1.0U
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Rinsate Blank	Method Blank	Site 7	Site 7 -DUP
Date	91101	91301	91801	91801	91101	91101
Total Dissolved Solids (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
Suspended Solids (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
Hardness, Carbonate (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
priority pollutants - semivolatiles (ug/l)						
acenaphthene	330U	330U	10U	10U	460U	480U
acenaphthylene	330U	330U	10U	10U	460U	480U
anthracene	330U	330U	10U	10U	460U	480U
benzidine	2700U	2700U	80U	80U	3800U	3900U
benzo(a)anthracene	330U	330U	10U	10U	460U	480U
benzo(a)pyrene	330U	330U	10U	10U	460U	480U
benzo(b)fluoranthene	330U	330U	10U	10U	460U	480U
benzo(g,h,I)perylene	330U	330U	10U	10U	460U	480U
benzo(k)fluoranthene	330U	30J	10U	10U	460U	480U
bis(2-chloroethoxy)methane	330U	330U	10U	10U	460U	480U
bis(2-chloroethyl)ether	330U	330U	10U	10U	460U	480U
2,2'-oxybis(1-chloropropane)	330U	330U	10U	10U	460U	480U
bis(2-ethylhexyl)phthalate	330U	330U	32B	0.56J	460U	480U
4-bromophenylphenyl ether	330U	330U	10U	10U	460U	480U
butylbenzylphthalate	330U	330U	10U	10U	460U	480U
2-chloronaphthalene	330U	330U	10U	10U	460U	480U
4-chlorophenylphenyl ether	330U	330U	10U	10U	460U	480U
chrysene	330U	330U	10U	10U	460U	480U
dibenzo(a,h)anthracene	330U	330U	10U	10U	460U	480U
1,2-dichlorobenzene	330U	330U	10U	10U	460U	480U
1,3-dichlorobenzene	330U	330U	10U	10U	460U	480U
1,4-dichlorobenzene	330U	330U	10U	10U	460U	480U
3,3'-dichlorobenzidine	660U	660U	20U	20U	920U	960U
diethylphthalate	330U	330U	10U	10U	460U	480U
dimethylphthalate	330U	330U	10U	10U	460U	480U
di-n-butylphthalate	330U	330U	10U	10U	460U	480U
2,4-dinitrotoluene	330U	330U	10U	10U	460U	480U
2,6-dinitrotoluene	330U	330U	10U	10U	460U	480U
di-n-octylphthalate	330U	330U	10U	10U	460U	480U

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Rinsate Blank	Method Blank	Site 7	Site 7 -DUP
priority pollutants - semivolatiles (u	91101	91301	91801	91801	91101	91101
1,2-diphenylhydrazine	330U	330U	10U	10U	460U	480U
fluoranthene	330U	330U	10U	10U	460U	480U
fluorene	330U	330U	10U	10U	460U	480U
hexachlorobenzene	330U	330U	10U	10U	460U	480U
hexachlorobutadiene	330U	330U	10U	10U	460U	480U
hexachlorocyclopentadiene	330U	330U	10U	10U	460U	480U
hexachlorethane	330U	330U	10U	10U	460U	480U
indeno(1,2,3-cd)pyrene	330U	330U	10U	10U	460U	480U
isophorone	330U	330U	10U	10U	460U	480U
naphthalene	330U	330U	7J	10U	460U	480U
nitrobenzene	330U	330U	10U	10U	460U	480U
n-nitrosodimethylamine	330U	330U	10U	10U	460U	480U
n-nitrosodi-n-propylamine	330U	330U	10U	10U	460U	480U
n-nitrosodiphenylamine	330U	330U	10U	10U	460U	480U
phenanthrene	330U	330U	10U	10U	460U	480U
pyrene	330U	330U	10U	10U	460U	480U
1,2,4-trichlorobenzene	330U	330U	10U	10U	460U	480U
2-chlorophenol	330U	330U	10U	10U	460U	480U
2,4-dichlorophenol	330U	330U	10U	10U	460U	480U
2,4-dimethylphenol	330U	330U	10U	10U	460U	480U
4,6-dinitro-2-methylphenol	1700U	1700U	50U	50U	2400U	2500U
2,4-dinitrophenol	1700U	1700U	50U	50U	2400U	2500U
2-nitrophenol	330U	330U	10U	10U	460U	480U
4-nitrophenol	1700U	1700U	50U	50U	2400U	2500U
4-chloro-3-methylphenol	330U	330U	10U	10U	460U	480U
pentachlorophenol	1700U	1700U	50U	50U	2400U	2500U
phenol	330U	330U	10U	10U	460U	480U
2,4,6-trichlorophenol	330U	330U	10U	10U	460U	480U

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Rinsate Blank	Method Blank	Site 7	Site 7 -DUP
Chlorinated Pesticides (ug/l)	91101	91301	91801	91801	91101	91101
aldrin	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
alpha-BHC	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
beta-BHC	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
gamma_BHC (lindane)	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
delta-BHC	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
chlordane	17U	17U	0.5U	0.5U	24U	25U
4,4'-DDD	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
4,4'-DDE	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
4,4'-DDT	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
dieldrin	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
endosulfan I	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
endosulfan II	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
endosulfan sulfate	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
endrin	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
endrin aldehyde	3.3U	3.3U	0.1U	0.1U	4.6U	4.8U
heptachlor	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
heptachlor epoxide	1.7U	1.7U	0.05U	0.05U	2.4U	2.5U
toxaphene	170U	170U	5.0U	5.0U	240U	250U
PCBs (ug/l)						
aroclor-1016	33U	33U	1.0U	1.0U	46U	48U
aroclor-1221	67U	67U	2.0U	2.0U	93U	97U
aroclor-1232	33U	33U	1.0U	1.0U	46U	48U
aroclor-1242	33U	33U	1.0U	1.0U	46U	48U
aroclor-1248	33U	33U	1.0U	1.0U	46U	48U
aroclor-1254	33U	33U	1.0U	1.0U	46U	48U
aroclor-1260	33U	33U	1.0U	1.0U	46U	48U

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank 91101	Method Blank 91301	Rinsate Blank 91801	Method Blank 91801	Site 7 91101	Site 7 -DUP 91101
Priority Pollutant - Metals (ug/l)						
antimony	2.0U	2.0U	20U	4.7B	0.65BN	0.66BN
arsenic	0.50U	0.50U	5.0U	5.0U	3.9	1.8
beryllium	0.20U	0.20U	0.11B	1.0U	0.52	0.59
cadmium	0.20U	0.20U	5.0U	5.0U	0.058B	0.13B
chromium	0.19B	0.19B	3.0U	3.0U	4	11
copper	0.10B	0.10B	2.1B	5.0U	4.5	4.9
lead	5.0U	5.0U	10U	10U	5.8B	4.9B
nickel	5.0U	5.0U	5.0U	5.0U	6.5	7.6
selenium	0.59B	0.59B	5.0U	5.0U	1.3U	1.4U
silver	1.0U	1.0U	10U	10U	1.3U	1.4U
thallium	1.0U	1.0U	10U	10U	1.3	1.4U
zinc	5.0U	5.0U	10U	10U	25	35
mercury	0.020U	0.020U	0.20U	0.20U	0.0065B	0.0082B
Phenolics, Total (mg/l)	1.0U	1.0U	0.012B	0.011B	1.4U	1.5U
Cyanide, Total (mg/l)	1.0U	1.0U	0.010U	0.010U	1.4U	1.5U
Nitrate + Nitrite-N (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
ammonia as N (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
Total Phosphorus (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
Total Kjeldahl Nitrogen-N (mg/l)	N/A	N/A	N/A	N/A	N/A	N/A
Total Organic Carbon (mg/l)	500U	500U	1.0U	1.0U	8200	9100
Acid Volatile Sulfide (mg/kg)	10U	10U			14U	14U
Acid Volatile Sulfide Extractable Metals (mg/kg)						
cadmium	0.072U	0.072U			0.040B	0.039B
copper	0.060B	0.060B			2.1	1.5
nickel	0.028B	0.028B			1.2	1.1
zinc	0.12B	0.12B			6.7E	6.3E
lead	0.072U	0.072U			2.2	2
Grain Size						
%gravel					0	6.1
%sand					89.1	89
%silt					10.1	3.1
%clay					0.8	1.8

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank 91101	Method Blank 91301	Rinsate Blank 91801	Method Blank 91801	Site 7 91101	Site 7 -DUP 91101
Volatile Organic Compounds (ug/l)						
acrolein	100U	100U	20U	20U	170U	600U
acrylonitrile	100U	100U	20U	20U	170U	600U
benzene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
bromoform	5.0U	5.0U	1.0U	1.0U	8.7U	30U
carbon tetrachloride	5.0U	5.0U	1.0U	1.0U	8.7U	30U
chlorobenzene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
dibromochloromethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
chlorethane	10U	10U	1.0U	1.0U	17U	60U
2-chloroethylvinyl ether	50UJ	50UJ	10U	10U	87UJ	300UJ
chloroform	5.0U	5.0U	1.0U	1.0U	8.7U	30U
dichlorobromomethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,1-dichloroethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,2-dichloroethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,1-dichloroethene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,2-dichloropropane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,3-dichloropropylene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
ethylbenzene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
bromomethane	10U	10U	1.0U	1.0U	17U	60U
chloromethane	10U	10U	1.0U	1.0U	17U	60U
methylene chloride	5.0U	5.0U	5.0U	5.0U	3.4J	30U
1,1,2,2-tetrachloroethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
tetrachloroethene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
toluene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
trans-1,2-dichloroethene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,1,1-trichloroethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
1,1,2-trichloroethane	5.0U	5.0U	1.0U	1.0U	8.7U	30U
trichlorethene	5.0U	5.0U	1.0U	1.0U	8.7U	30U
vinyl chloride	10U	10U	1.0U	1.0U	17U	60U

B (inorganic) - reported value is < the Project Reporting Limit (PRL) but ≥ to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

* - duplicate analysis not within control limits.

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Trip Blank 91001	Field Blank 91001	Method Blank 91101	Method Blank 91101	Trip Blank 91101	Method Blank 91301	Trip Blank 91301
Total Dissolved Solids (mg/l)	N/A	N/A	5.0U	5.0U	N/A	5.0U	N/A
Suspended Solids (mg/l)	N/A	N/A	5.0U	5.0U	N/A	5.0U	N/A
Hardness, Carbonate (mg/l)	N/A	N/A	10U	10U	N/A	10U	N/A
priority pollutants - semivolatiles (ug/l)							
acenaphthene	N/A	10U	10U	N/A	N/A	10U	N/A
acenaphthylene	N/A	10U	10U	N/A	N/A	10U	N/A
anthracene	N/A	10U	10U	N/A	N/A	10U	N/A
benzidine	N/A	80U	80U	N/A	N/A	80U	N/A
benzo(a)anthracene	N/A	10U	10U	N/A	N/A	10U	N/A
benzo(a)pyrene	N/A	10U	10U	N/A	N/A	10U	N/A
benzo(b)fluoranthene	N/A	10U	10U	N/A	N/A	10U	N/A
benzo(g,h,I)perylene	N/A	10U	10U	N/A	N/A	10U	N/A
benzo(k)fluoranthene	N/A	10U	10U	N/A	N/A	10U	N/A
bis(2-chloroethoxy)methane	N/A	10U	10U	N/A	N/A	10U	N/A
bis(2-chloroethyl)ether	N/A	10U	10U	N/A	N/A	10U	N/A
2,2'-oxybis(1-chloropropane)	N/A	10U	10U	N/A	N/A	10U	N/A
bis(2-ethylhexyl)phthalate	N/A	10U	10U	N/A	N/A	10U	N/A
4-bromophenylphenyl ether	N/A	10U	10U	N/A	N/A	10U	N/A
butylbenzylphthalate	N/A	10U	10U	N/A	N/A	10U	N/A
2-chloronaphthalene	N/A	10U	10U	N/A	N/A	10U	N/A
4-chlorophenylphenyl ether	N/A	10U	10U	N/A	N/A	10U	N/A
chrysene	N/A	10U	10U	N/A	N/A	10U	N/A
dibenzo(a,h)anthracene	N/A	10U	10U	N/A	N/A	10U	N/A
1,2-dichlorobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
1,3-dichlorobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
1,4-dichlorobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
3,3'-dichlorobenzidine	N/A	20U	20U	N/A	N/A	20U	N/A
diethylphthalate	N/A	10U	10U	N/A	N/A	10U	N/A
dimethylphthalate	N/A	10U	10U	N/A	N/A	10U	N/A
di-n-butylphthalate	N/A	10U	10U	N/A	N/A	10U	N/A
2,4-dinitrotoluene	N/A	10U	10U	N/A	N/A	10U	N/A
2,6-dinitrotoluene	N/A	10U	10U	N/A	N/A	10U	N/A
di-n-octylphthalate	N/A	10U	10U	N/A	N/A	10U	N/A

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Trip Blank	Field Blank	Method Blank	Method Blank	Trip Blank	Method Blank	Trip Blank
priority pollutants - semivolatiles (u	91001	91001	91101	91101	91101	91301	91301
1,2-diphenylhydrazine	N/A	10U	10U	N/A	N/A	10U	N/A
fluoranthene	N/A	10U	10U	N/A	N/A	10U	N/A
fluorene	N/A	10U	10U	N/A	N/A	10U	N/A
hexachlorobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
hexachlorobutadiene	N/A	10U	10U	N/A	N/A	10U	N/A
hexachlorocyclopentadiene	N/A	10U	10U	N/A	N/A	10U	N/A
hexachlorethane	N/A	10U	10U	N/A	N/A	10U	N/A
indeno(1,2,3-cd)pyrene	N/A	10U	10U	N/A	N/A	10U	N/A
isophorone	N/A	10U	10U	N/A	N/A	10U	N/A
naphthalene	N/A	10U	10U	N/A	N/A	10U	N/A
nitrobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
n-nitrosodimethylamine	N/A	10U	10U	N/A	N/A	10U	N/A
n-nitrosodi-n-propylamine	N/A	10U	10U	N/A	N/A	10U	N/A
n-nitrosodiphenylamine	N/A	10U	10U	N/A	N/A	10U	N/A
phenanthrene	N/A	10U	10U	N/A	N/A	10U	N/A
pyrene	N/A	10U	10U	N/A	N/A	10U	N/A
1,2,4-trichlorobenzene	N/A	10U	10U	N/A	N/A	10U	N/A
2-chlorophenol	N/A	10U	10U	N/A	N/A	10U	N/A
2,4-dichlorophenol	N/A	10U	10U	N/A	N/A	10U	N/A
2,4-dimethylphenol	N/A	10U	10U	N/A	N/A	10U	N/A
4,6-dinitro-2-methylphenol	N/A	50U	50U	N/A	N/A	50U	N/A
2,4-dinitrophenol	N/A	50U	50U	N/A	N/A	50U	N/A
2-nitrophenol	N/A	10U	10U	N/A	N/A	10U	N/A
4-nitrophenol	N/A	50U	50U	N/A	N/A	50U	N/A
4-chloro-3-methylphenol	N/A	10U	10U	N/A	N/A	10U	N/A
pentachlorophenol	N/A	50U	50U	N/A	N/A	50U	N/A
phenol	N/A	10U	10U	N/A	N/A	10U	N/A
2,4,6-trichlorophenol	N/A	10U	10U	N/A	N/A	10U	N/A

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Trip Blank	Field Blank	Method Blank	Method Blank	Trip Blank	Method Blank	Trip Blank
Chlorinated Pesticides (ug/l)	91001	91001	91101	91101	91101	91301	91301
aldrin	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
alpha-BHC	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
beta-BHC	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
gamma_BHC (lindane)	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
delta-BHC	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
chlordane	N/A	0.5U	0.5U	N/A	N/A	0.5U	N/A
4,4'-DDD	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
4,4'-DDE	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
4,4'-DDT	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
dieldrin	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
endosulfan I	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
endosulfan II	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
endosulfan sulfate	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
endrin	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
endrin aldehyde	N/A	0.1U	0.1U	N/A	N/A	0.1U	N/A
heptachlor	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
heptachlor epoxide	N/A	0.05U	0.05U	N/A	N/A	0.05U	N/A
toxaphene	N/A	5.0U	5.0U	N/A	N/A	5.0U	N/A
PCBs (ug/l)							
aroclor-1016	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A
aroclor-1221	N/A	2.0U	2.0U	N/A	N/A	2.0U	N/A
aroclor-1232	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A
aroclor-1242	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A
aroclor-1248	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A
aroclor-1254	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A
aroclor-1260	N/A	1.0U	1.0U	N/A	N/A	1.0U	N/A

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Trip Blank 91001	Field Blank 91001	Method Blank 91101	Method Blank 91101	Trip Blank 91101	Method Blank 91301	Trip Blank 91301
Priority Pollutant - Metals (ug/l)							
antimony	N/A	20U	20U	N/A	N/A	20U	N/A
arsenic	N/A	5.0U	5.0U	N/A	N/A	5.0U	N/A
beryllium	N/A	1.0U	0.17B	N/A	N/A	1.0U	N/A
cadmium	N/A	5.0U	5.0U	N/A	N/A	5.0U	N/A
chromium	N/A	3.0U	3.0U	N/A	N/A	1.1B	N/A
copper	N/A	2.8B	1.2B	N/A	N/A	5.0U	N/A
lead	N/A	10U	10U	N/A	N/A	10U	N/A
nickel	N/A	5.0U	5.0U	N/A	N/A	5.0U	N/A
selenium	N/A	5.0U	5.0U	N/A	N/A	5.0U	N/A
silver	N/A	10U	10U	N/A	N/A	10U	N/A
thallium	N/A	10U	10U	N/A	N/A	10U	N/A
zinc	N/A	10U	10U	N/A	N/A	2.5B	N/A
mercury	N/A	0.20U	0.20U	N/A	N/A	0.20U	N/A
Phenolics, Total (mg/l)	N/A	0.050U	0.050U	N/A	N/A	0.011B	N/A
Cyanide, Total (mg/l)	N/A	0.010U	0.010U	N/A	N/A	0.010U	N/A
Nitrate + Nitrite-N (mg/l)	N/A	0.050U	0.050U	0.050U	N/A	0.050U	N/A
ammonia as N (mg/l)	N/A	0.030U	0.030U	0.030U	N/A	0.030U	N/A
Total Phosphorus (mg/l)	N/A	0.10U	0.077B	0.10U	N/A	0.10U	N/A
Total Kjeldahl Nitrogen-N (mg/l)	N/A	0.20U	0.20U	0.13B	N/A	0.13B	N/A
Total Organic Carbon (mg/l)	N/A	1.0U	1.0U	1.0U	N/A	1.0U	N/A

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Trip Blank 91001	Field Blank 91001	Method Blank 91101	Method Blank 91101	Trip Blank 91101	Method Blank 91301	Trip Blank 91301
VOCs (ug/l)							
acrolein	20U	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	.22J
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	0.42J	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	.36J	1.0U	1.0U	1.0U	.56J	1.0U	.35J
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	.26J
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%

Quality assurance/quality control results for the September 2001 sampling in the Indian Creek watershed, Tazewell County, Virginia

* - duplicate analysis not within control limits.

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

Sediments	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**	**Site 11**
priority pollutants - semivolatiles (ug/kg)											
acenaphthene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
acenaphthylene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
anthracene	540U	250J	1000U	530U	430U	39J	410U	460U	460U	490U	460U
benzidine	4500U	7500U	8400U	4400U	3500U	3800U	3400U	3800U	3800U	4000U	3800U
benzo(a)anthracene	540U	520J	1000U	530U	430U	150J	410U	460U	460U	490U	460U
benzo(a)pyrene	540U	410J	1000U	530U	430U	130J	410U	460U	460U	490U	460U
benzo(b)fluoranthene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
benzo(g,h,I)perylene	540U	270J	1000U	530U	430U	80J	410U	460U	460U	490U	460U
benzo(k)fluoranthene	540U	390J	1000U	530U	430U	110J	410U	460U	460U	490U	460U
bis(2-chloroethoxy)methane	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
bis(2-chloroethyl)ether	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,2'-oxybis(1-chloropropane) [bis(2-chloroisopropyl) ether]	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
bis(2-ethylhexyl)phthalate	540U	180J	190J	530U	430U	460U	410U	460U	460U	490U	460U
4-bromophenylphenyl ether	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
butylbenzylphthalate	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2-chloronaphthalene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
4-chlorophenylphenyl ether	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
chrysene	540U	540J	1000U	530U	430U	200J	410U	460U	460U	490U	460U
dibenzo(a,h)anthracene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
1,2-dichlorobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
1,3-dichlorobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
1,4-dichlorobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
3,3'-dichlorobenzidine	1100U	1800U	2100U	1100U	1100U	930U	820U	930U	980U	980U	920U
diethylphthalate	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
dimethylphthalate	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
di-n-butylphthalate	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,4-dinitrotoluene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,6-dinitrotoluene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
di-n-octylphthalate	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
1,2-diphenylhydrazine	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
fluoranthene	540U	1100	1000U	530U	430U	280J	410U	460U	460U	490U	460U
fluorene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
hexachlorobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
hexachlorobutadiene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
hexachlorocyclopentadiene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
hexachlorethane	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
indeno(1,2,3-cd)pyrene	540U	260J	1000U	530U	430U	460U	410U	460U	460U	490U	460U
isophorone	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
naphthalene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
nitrobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

SVOC cont.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
n-nitrosodimethylamine	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
n-nitrosodi-n-propylamine	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
n-nitrosodiphenylamine	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
phenanthrene	540U	850J	1000U	530U	430U	290J	410U	460U	460U	490U	460U
pyrene	540U	1000	1000U	530U	430U	500	410U	460U	460U	490U	460U
1,2,4-trichlorobenzene	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2-chlorophenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,4-dichlorophenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,4-dimethylphenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
4,6-dinitro-2-methylphenol	2800U	4700U	5300U	2700U	2200U	2400U	2100U	2400U	2400U	2500U	2400U
2,4-dinitrophenol	2800U	4700U	5300U	2700U	2200U	2400U	2100U	2400U	2400U	2500U	2400U
2-nitrophenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
4-nitrophenol	2800U	4700U	5300U	2700U	2200U	2400U	2100U	2400U	2400U	2500U	2400U
4-chloro-3-methylphenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
pentachlorophenol	2800U	4700U	5300U	2700U	2200U	2400U	2100U	2400U	2400U	2500U	2400U
phenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
2,4,6-trichlorophenol	540U	920U	1000U	530U	430U	460U	410U	460U	460U	490U	460U
Chlorinated Pesticides (ug/kg)											
aldrin	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
alpha-BHC	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
beta-BHC	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
gamma_BHC (lindane)	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
delta-BHC	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
chlordane	56U	94U	110U	55U	22U	24U	21U	24U	24U	25U	24U
4,4'-DDD	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
4,4'-DDE	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
4,4'-DDT	11U	18U	21U	3.8J	4.3U	4.6U	4.1U	0.79J	4.6U	4.9U	4.6U
dieldrin	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
endosulfan I	11U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
endosulfan II	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
endosulfan sulfate	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
endrin	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
endrin aldehyde	11U	18U	21U	11U	4.3U	4.6U	4.1U	4.6U	4.6U	4.9U	4.6U
heptachlor	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
heptachlor epoxide	5.6U	9.4U	11U	5.5U	2.2U	2.4U	2.1U	2.4U	2.4U	2.5U	2.4U
toxaphene	560U	940U	1100U	550U	220U	240U	210U	240U	240U	250U	240U
PCBs (ug/kg)											
aroclor-1016	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U
aroclor-1221	220U	370U	420U	220U	87U	94U	84U	94U	94U	100U	93U
aroclor-1232	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U
aroclor-1242	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U
aroclor-1248	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U
aroclor-1254	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U
aroclor-1260	110U	180U	210U	110U	43U	46U	41U	46U	46U	49U	46U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
Priority Pollutant - Metals (mg/kg)											
antimony	2.7UN	5.6UN	5.7UN	2.7UN	2.4UN	2.8UN	2.3UN	2.6UN	0.64BN	2.7UN	2.5UN
arsenic	4.1	11	31	17	1.9	2.3	2.6	1.5	4.3	2	1.2
beryllium	0.5	1.3	2.9	0.93	0.32	0.29	0.42	0.42	0.73	0.48	0.3
chromium	5.6N	28N	84N	38N	3.5N	3.7N	7.4N	3.2N	7.8	4.1	2.7N
copper	7.4NE*	22NE*	25NE*	13NE*	4.4NE*	4.0NE*	3.9NE*	4.0NE*	6.6	4.2	2.5NE*
lead	8.7E	34E	50E	24E	6.0E	4.8BE	4.9BE	4.7BE	8.9	5.9B	3.7BE
nickel	9	22	40	19	5.4B	5.2B	5.7	5.2B	8.6	6.1B	4.2B
selenium	1.4U	2.8U	2.8U	1.3U	1.2U	1.4U	1.1U	1.3U	1.4U	1.4U	1.3U
silver	1.4U	2.8U	2.8U	1.3U	1.2U	1.4U	1.1U	1.3U	1.4U	1.4U	1.3U
thallium	1.4U	2.8U	2.8U	1.3U	1.2U	1.4U	1.1U	1.3U	1.4U	1.4U	1.3U
zinc	38NE	120NE	270NE	69NE	27NE	25NE	24NE	23NE	40E	26E	18NE
cadmium	0.12B	0.33B	0.27B	0.21B	0.038B	0.028B	0.035B	0.033B	0.040B	0.051B	0.034B
mercury	0.017B	0.047B	0.39B	0.21B	0.0066B	0.0061B	0.0063B	0.026U	0.011B	0.016B	0.028U
Phenolics, Total mg/kg	1.3B	4	1.6U	0.32B	0.54B	0.7U	0.85B	0.48B	2	0.75U	0.44B
Cyanide, Total mg/kg	1.6U	2.8U	3.1U	1.6U	1.3U	1.4U	1.2U	1.4U	1.4U	1.5U	1.3U
Total Organic Carbon mg/kg	20000	43000	44000	23000	7600	3800	5100	5400	5600	16000	2300
Volatile Organic Compounds (ug/kg)											
acrolein ug/kg	170U	250U	270U	110U	120U	700U	280U	700U	410U	160U	170U
acrylonitrile ug/kg	170U	250U	270U	110U	120U	700U	280U	700U	410U	160U	170U
benzene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
bromoform ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
carbon tetrachloride ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
chlorobenzene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
dibromochloromethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
chlorethane ug/kg	17U	25U	27U	11U	12U	70U	28U	70U	41U	16U	17U
2-chloroethylvinyl ether ug/kg	84UJ	130UJ	130UJ	54UJ	59UJ	350UJ	140UJ	350UJ	210UJ	83UJ	87UJ
chloroform ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	14U	8.3U	8.7U
dichlorobromomethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,1-dichloroethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,2-dichloroethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,1-dichloroethene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,2-dichloropropane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,3-dichloropropylene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
ethylbenzene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
bromomethane ug/kg	17U	25U	27U	11U	12U	70U	28U	70U	41U	16U	17U
chloromethane ug/kg	17U	25U	27U	11U	12U	70U	28U	70U	41U	16U	17U
methylene chloride ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,1,2,2-tetrachloroethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
tetrachloroethene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
toluene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	19J	8.3U	8.7U
trans-1,2-dichloroethene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,1,1-trichloroethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
1,1,2-trichloroethane ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	21U	8.3U	8.7U
trichlorethene ug/kg	8.4U	13U	13U	5.4U	5.9U	35U	14U	35U	14U	8.3U	8.7U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

vinyl chloride ug/kg	17U	25U	27U	11U	12U	70U	28U	70U	41U	16U	17U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

	Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**	**Site 7**	**Site 8**	**Site 9**	**Site 10**	**Site 11**
Acid Volatile Sulfide (mg/kg)	16U	330	340	16U	13U	14U	13U	14U	14U	15U	14U
Acid Volatile Sulfide Extractable Metals (mg/kg)											
AVS cadmium mg/kg	0.044B	0.19B	0.24	0.23	0.032B	0.020B	0.021B	0.013B	0.020B	0.020B	0.023B
AVS copper mg/kg	2.1	7.1	6.5	2.8	0.84	0.96	0.71	0.8	1.9	1.1	0.76
AVS nickel mg/kg	1.5	3.6	3.5	1.2	0.57B	0.37B	0.60B	0.63B	0.72B	0.78B	0.62B
AVS zinc mg/kg	7.6NE	45NE	55NE	57NE	4.4NE	3.4NE	4.8NE	3.7NE	7.5N	4.5N	4.7NE
AVS lead mg/kg	3.4E	16E	17E	8.5E	1.7E	1.4E	2.2E	8.6E	2.9	1.6	1.3E
Grain Size											
Grain size %gravel	3.9	13.0	31.4	2.9	4.9	0	3.7	0	3	3.2	0
Grain size %sand	79.7	42.4	37	60.3	92.1	95.5	92	96.6	91.1	86.7	97.2
Grain size %silt	12.7	33.0	21.4	29.1	2.2	2.8	3.2	2.5	3.8	9	1.9
Grain size %clay	3.7	11.6	10.2	7.7	0.8	1.7	1.1	0.9	2.1	1.1	0.9

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
priority pollutants - SVOC (ug/kg)											
acenaphthene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
acenaphthylene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
anthracene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
benzidine	3500U	3400U	4600U	4100U	3500U	3800U	3800U	4100U	4600U	4500U	5400U
benzo(a)anthracene	430U	410U	560U	500U	430U	460U	470U	500U	52J	550U	660U
benzo(a)pyrene	430U	410U	560U	500U	430U	460U	470U	500U	54J	550U	660U
benzo(b)fluoranthene	430U	410U	560U	500U	430U	460U	470U	500U	77J	550U	660U
benzo(g,h,I)perylene	430U	410U	560U	500U	430U	460U	470U	500U	56J	550U	660U
benzo(k)fluoranthene	430U	410U	560U	500U	430U	460U	470U	500U	46J	550U	660U
bis(2-chloroethoxy)methane	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
bis(2-chloroethyl)ether	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,2'-oxybis(1-chloropropane) [bis(2-chloroisopropyl) ether]	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
bis(2-ethylhexyl)phthalate	430U	120J	290J	500U	430U	460U	470U	500U	570U	550U	660U
4-bromophenylphenyl ether	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
butylbenzylphthalate	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2-chloronaphthalene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
4-chlorophenylphenyl ether	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
chrysene	430U	410U	560U	500U	430U	460U	470U	500U	80J	550U	660U
dibenzo(a,h)anthracene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
1,2-dichlorobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
1,3-dichlorobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
1,4-dichlorobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
3,3'-dichlorobenzidine	860U	820U	1100U	1000U	860U	920U	940U	1000U	1100U	1100U	1300U
diethylphthalate	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
dimethylphthalate	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
di-n-butylphthalate	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,4-dinitrotoluene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,6-dinitrotoluene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
di-n-octylphthalate	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
1,2-diphenylhydrazine	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
fluoranthene	430U	410U	560U	500U	430U	460U	470U	500U	120J	550U	660U
fluorene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
hexachlorobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
hexachlorobutadiene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
hexachlorocyclopentadiene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
hexachlorethane	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
indeno(1,2,3-cd)pyrene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
isophorone	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
naphthalene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
nitrobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

SVOC cont.	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
n-nitrosodimethylamine	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
n-nitrosodi-n-propylamine	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
n-nitrosodiphenylamine	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
phenanthrene	430U	410U	560U	500U	430U	460U	470U	500U	31J	32J	660U
pyrene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
1,2,4-trichlorobenzene	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2-chlorophenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,4-dichlorophenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,4-dimethylphenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
4,6-dinitro-2-methylphenol	2200U	2100U	2900U	2600U	2200U	2400U	2400U	2600U	2900U	2800U	3400U
2,4-dinitrophenol	2200U	2100U	2900U	2600U	2200U	2400U	2400U	2600U	2900U	2800U	3400U
2-nitrophenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
4-nitrophenol	2200U	2100U	2900U	2600U	2200U	2400U	2400U	2600U	2900U	2800U	3400U
4-chloro-3-methylphenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
pentachlorophenol	2200U	2100U	2900U	2600U	2200U	2400U	2400U	2600U	2900U	2800U	3400U
phenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
2,4,6-trichlorophenol	430U	410U	560U	500U	430U	460U	470U	500U	570U	550U	660U
Chlorinated Pesticides (ug/kg)											
aldrin	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	2.9U	2.8U	6.8U
alpha-BHC	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	0.38JP	0.98JP	2.8U	6.8U
beta-BHC	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	2.9U	2.8U	6.8U
gamma_BHC (lindane)	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	2.9U	2.8U	6.8U
delta-BHC	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	0.25JP	2.8U	6.8U
chlordane	22U	21U	29U	26U	22U	24U	24U	26U	29U	28U	68U
4,4'-DDD	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
4,4'-DDE	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
4,4'-DDT	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	1.4J	0.74JP	5.5U	13U
dieldrin	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
endosulfan I	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	2.9U	2.8U	6.8U
endosulfan II	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
endosulfan sulfate	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
endrin	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	4.7U	5.0U	5.7U	5.5U	13U
endrin aldehyde	4.3U	4.1U	5.6U	5.0U	4.3U	4.6U	0.35JP	5.0U	5.7U	5.5U	13U
heptachlor	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	0.33JP	0.45JP	2.8U	6.8U
heptachlor epoxide	2.2U	2.1U	2.9U	2.6U	2.2U	2.4U	2.4U	2.6U	2.9U	2.8U	6.8U
toxaphene	220U	210U	290U	260U	220U	240U	240U	260U	290U	280U	680U
PCBs (ug/kg)											
aroclor-1016	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U
aroclor-1221	87U	84U	110U	100U	87U	93U	96U	100U	120U	110U	270U
aroclor-1232	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U
aroclor-1242	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U
aroclor-1248	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U
aroclor-1254	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U
aroclor-1260	43U	41U	56U	50U	43U	46U	47U	50U	57U	55U	130U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Priority Pollutant - Metals (mg/kg)											
antimony	2.4UN	2.5UN	3.1UN	3.0UN	2.4UN	2.5UN	2.6UN	1.0BN	3.1UN	3.0UN	3.6UN
arsenic	1.6	2.4	3.2	5.7	0.84	4.9	2.8	6.9	9.3	5.7	2.4
beryllium	0.28	0.51	0.78	1.1	0.26	0.83	0.34	0.56	0.49	0.45	0.97
chromium	2.6N	4.6N	7.4N	9.9N	2.4N	10	3.5N	7.9	9.1	6.3N	7.2N
copper	2.4NE*	4.3NE*	9.1NE*	15NE*	2.5NE*	9.5	3.8NE*	7.3	9.5	7.2NE*	11NE*
lead	3.8BE	4.7BE	12E	20E	3.0BE	11	8.0E	17	11	9.2E	10E
nickel	4.3B	6.9	11	13	4.1B	9.2	7	11	12	9.4	13
selenium	1.2U	1.2U	1.5U	1.5U	1.2U	1.3U	1.3U	1.4U	1.6U	1.5U	1.8U
silver	1.2U	1.2U	1.5U	1.5U	1.2U	1.3U	1.3U	1.4U	1.6U	1.5U	1.8U
thallium	1.2U	1.2U	1.5U	0.78B	1.2U	1.3U	1.3U	1.4U	1.6U	1.5U	1.8U
zinc	19NE	27NE	35NE	44NE	16NE	53E	28NE	67E	51E	42NE	45NE
cadmium	0.038B	0.035B	0.052B	0.056B	0.025B	0.038B	0.060B	0.050B	0.086B	0.16B	0.10B
mercury	0.022B	0.0086U	0.023B	0.021B	0.0066B	0.013B	0.0083B	0.017B	0.024B	0.018B	0.023B
Phenolics, Total (mg/kg)	0.65U	0.63U	0.85U	0.39B	1.3	0.69U	1.1B	1.7U	1.8	1.7	1.0U
Cyanide, Total (mg/kg)	1.3U	1.2U	1.6U	1.5U	1.3U	1.4U	1.4U	1.5U	1.7U	1.6U	1.9U
Total Organic Carbon (mg/kg)	27000	9400	36000	18000	2300	5400	9600	7000	14000	5900	99000
Volatile Organic Compounds (ug/kg)											
acrolein	180U	240U	160U	240U	380U	280U	100U	760U	450U	130U	380U
acrylonitrile	180U	240U	160U	240U	380U	280U	100U	760U	450U	130U	380U
benzene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
bromoform	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
carbon tetrachloride	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
chlorobenzene	8.8U	12U	8.1U	12U	19U	3.8J	5.2U	38U	23U	6.5U	19U
dibromochloromethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
chlorethane	18U	24U	16U	24U	38U	28U	10U	76U	45U	13U	38U
2-chloroethylvinyl ether	88UJ	120UJ	81UJ	120UJ	190UJ	140UJ	52UJ	380U	230UJ	65U	190UJ
chloroform	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	30U	19U
dichlorobromomethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,1-dichloroethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,2-dichloroethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,1-dichloroethene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,2-dichloropropane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,3-dichloropropylene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
ethylbenzene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
bromomethane	18U	24U	16U	24U	38U	28U	10U	76U	45U	13U	38U
chloromethane	18U	24U	16U	24U	38U	28U	10U	76U	45U	13U	38U
methylene chloride	8.8U	12U	8.1U	12U	19U	14U	3.4J	38U	23U	6.5U	19U
1,1,2,2-tetrachloroethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
tetrachloroethene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
toluene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
trans-1,2-dichloroethene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,1,1-trichloroethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
1,1,2-trichloroethane	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U
trichlorethene	8.8U	12U	8.1U	12U	19U	14U	5.2U	38U	23U	6.5U	19U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

vinyl chloride	18U	24U	16U	24U	38U	28U	10U	76U	37U	13U	38U

Analytical results of sediments in the Indian Creek watershed, Tazewell County, Virginia, May 2002.

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Acid Volatile Sulfide (mg/kg)	13U	12U	17U	15U	13U	14U	14U	15U	17U	17U	20U
Acid Volatile Sulfide Extractable Metals (mg/kg)											
cadmium	0.023B	0.013B	0.022B	0.34B	0.020B	0.038B	0.021B	0.025B	0.030B	0.071B	0.042B
copper	0.84	1	1.3	1.4	0.93	1.2	0.82	1.8	1.7	2.6	2.8
nickel	1	0.8	0.68B	0.68B	0.51B	0.61B	0.52B	0.89	1.2	1.7	2
zinc	5.9NE	3.4NE	2.4NE	1.9NE	3.5NE	9.2N	4.2NE	7.4N	6.1N	12NE	7.1NE
lead	1.2E	1.0E	3.6E	2.4E	1.2E	3.7	1.4E	2.6	2.9	4.3E	3.6E
Grain Size											
%gravel	5.6	10.8	19.9	4.3	0	1.4	0	5.1	0.8	1.7	0.5
%sand	86.9	84.7	53.9	74	90.2	83.7	97.3	86.9	38.7	89.1	60.6
%silt	6.5	2.9	16.9	16.3	9.1	14	1.8	4.5	49.4	6.9	33.7
%clay	1	1.6	9.3	5.4	0.7	0.9	0.9	3.5	11.1	2.3	5.2

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

Surface Water	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
Total Dissolved Solids (mg/l)	97	270	280	240	86	99	77	130	73	61	130
Suspended Solids (mg/l)	5.0U	5.0U	5	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
Hardness, Carbonate (mg/l)	100	260	270	220	81	66	56	79	55	55	98
priority pollutants - semivolatiles (ug/l)											
acenaphthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
acenaphthylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzidine	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U
benzo(a)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(a)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(b)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(g,h,I)perylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(k)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethoxy)methane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethyl)ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,2'-oxybis(1-chloropropane) [bis(2-chl	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-bromophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
butylbenzylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chloronaphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-chlorophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chrysene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dibenzo(a,h)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,3-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,4-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
3,3'-dichlorobenzidine	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
diethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dimethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-butylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,6-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-octylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-diphenylhydrazine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluorene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

SVOC cont.	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
hexachlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorobutadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorocyclopentadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorethane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
indeno(1,2,3-cd)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
isophorone	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
naphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
nitrobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodimethylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodi-n-propylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodiphenylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
phenanthrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2,4-trichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dimethylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4,6-dinitro-2-methylphenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2,4-dinitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2-nitrophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-nitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
4-chloro-3-methylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pentachlorophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
phenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4,6-trichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
Chlorinated Pesticides (ug/l)											
aldrin	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
gamma_BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
4,4'-DDD	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDE	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDT	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
dieldrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan I	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
endosulfan II	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan sulfate	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin aldehyde	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
heptachlor	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
heptachlor epoxide	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
toxaphene	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

PCBs	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
aroclor-1016	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1221	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
aroclor-1232	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1242	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1248	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1254	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1260	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Priority Pollutant - Metals (ug/l)											
antimony	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
arsenic	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
cadmium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U
copper	3.7B	3.3B	3.8B	3.6B	3.7B	3.6B	3.5B	3.3B	2.7B	2.3B	3.2B
lead	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
nickel	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
selenium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
silver	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
thallium	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
zinc	1.3B	2.2B	2.1B	1.1B	1.6B	3.7B	2.6B	1.3B	1.6B	1.6B	1.6B
mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Phenolics, Total (mg/l)	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U	0.010U
Nitrate + Nitrite-N (mg/l)	0.14	0.5	0.39	0.33	0.12	0.051	0.058	0.067	0.15	0.094	0.075
ammonia as N (mg/l)	0.027B	0.026B	0.03	0.024B	0.027B	0.024B	0.018B	0.025B	0.043	0.038	0.025B
Total Phosphorus (mg/l)	0.037B	0.10U	0.036B	0.056B	0.10U	0.10U	0.046B	0.049B	0.046B	0.10U	0.045B
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.13B	0.13B	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Total Organic Carbon (mg/l)	0.90B	1.3	1.3	1.5	0.81B	1	0.82B	0.85B	0.61B	0.84B	1.1

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

VOCs (ug/l)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11
acrolein	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	0.59J	1.0U	1.0U	1.0U	1.0U
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
Total Dissolved Solids (mg/l)	120	94	190	60	87	73	84	110	120	120	63
Suspended Solids (mg/l)	8	5	240	9	5.0U	5.0U	5.0U	5.0U	130	5.0U	8
Hardness, Carbonate (mg/l)	93	77	72	45	73	70	68	96	120	100	50
priority pollutants - semivolatiles (ug/l)											
acenaphthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
acenaphthylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzidine	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U	80U
benzo(a)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(a)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(b)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(g,h,I)perylene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
benzo(k)fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethoxy)methane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-chloroethyl)ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,2'-oxybis(1-chloropropane)	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
bis(2-ethylhexyl)phthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-bromophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
butylbenzylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chloronaphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-chlorophenylphenyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chrysene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dibenzo(a,h)anthracene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,3-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,4-dichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
3,3'-dichlorobenzidine	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
diethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
dimethylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-butylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,6-dinitrotoluene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
di-n-octylphthalate	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2-diphenylhydrazine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluoranthene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
fluorene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

SVOC cont.	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
hexachlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorobutadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorocyclopentadiene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
hexachlorethane	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
indeno(1,2,3-cd)pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
isophorone	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
naphthalene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
nitrobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodimethylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodi-n-propylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
n-nitrosodiphenylamine	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
phenanthrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pyrene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
1,2,4-trichlorobenzene	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2-chlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4-dimethylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4,6-dinitro-2-methylphenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2,4-dinitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
2-nitrophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
4-nitrophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
4-chloro-3-methylphenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
pentachlorophenol	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U	50U
phenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
2,4,6-trichlorophenol	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
Chlorinated Pesticides (ug/l)											
aldrin	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
alpha-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
beta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
gamma_BHC (lindane)	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
delta-BHC	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
chlordane	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
4,4'-DDD	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDE	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
4,4'-DDT	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
dieldrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan I	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
endosulfan II	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endosulfan sulfate	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
endrin aldehyde	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
heptachlor	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
heptachlor epoxide	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U	0.05U
toxaphene	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

PCBs	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
aroclor-1016	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1221	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U	2.0U
aroclor-1232	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1242	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1248	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1254	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
aroclor-1260	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
PP - Metals (ug/l)											
antimony	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
arsenic	5.0U	5.0U	6.5	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
beryllium	1.0U	1.0U	1.2	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
cadmium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
chromium	3.0U	3.0U	11	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U
copper	3.0B	3.0B	17	3.1B	3.6B	3.1B	7.0	3.1B	3.0B	3.3B	3.1B
lead	10U	10U	6.3B	10U	10U	10U	10U	10U	10U	10U	10U
nickel	5.0U	5.0U	16	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
selenium	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
silver	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
thallium	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
zinc	1.3B	2.3B	57	5.5B	1.9B	2.3B	1.3B	2.0B	3.8B	1.8B	1.9B
mercury	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U
Phenolics, Total (mg/l)	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	0.010U	0.010U	0.010U	0.0085B	0.010U	0.010U	0.010U	0.010U	0.010U
Nitrate + Nitrite-N (mg/l)	0.14	0.081	0.032B	0.05	0.085	0.1	0.76	0.072	0.28	0.12	0.07
ammonia as N (mg/l)	0.022B	0.034	0.16	0.037	0.028B	0.066	0.020B	0.11	0.08	0.024B	0.092
Total Phosphorus (mg/l)	0.038B	0.10U	0.33	0.10U	0.035B	0.049B	0.10U	0.034B	0.067B	0.037B	0.04B
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.20U	0.87	0.20U	0.20U	0.20U	0.20U	0.20U	0.27	0.20U	0.20U
Total Organic Carbon (mg/l)	0.81B	1.2	1.2	0.98B	1	1	0.70B	2	1.2	2	1.5

Analytical results of surface water samples collected in the Indian Creek watershed, Tazewell County, Virginia, May 2002

VOCs (ug/l)	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Site 18	Site 19	Site 20	Site 21	Site 22
acrolein	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	0.19J	1.0U	0.16J	1.0U	1.0U
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Site 2	Site 2 dup	Rinsate Blank	DI
date	51602	51402			51502	51502
Total Dissolved Solids (mg/l)	N/A	N/A	N/A	N/A	5.0U	5.0U
Suspended Solids (mg/l)	N/A	N/A	N/A	N/A	5.0U	5.0U
Hardness, Carbonate (mg/l)	N/A	N/A	N/A	N/A	10U	10U
priority pollutants - semivolatiles (ug/l)						
acenaphthene	330U	330U	920U	720U	10U	10U
acenaphthylene	330U	330U	920U	720U	10U	10U
anthracene	330U	330U	250J	720U	10U	10U
benzidine	2700U	2700U	7500U	5900U	80U	80U
benzo(a)anthracene	330U	330U	520J	130J	10U	10U
benzo(a)pyrene	330U	330U	410J	130J	10U	10U
benzo(b)fluoranthene	330U	330U	920U	720U	10U	10U
benzo(g,h,I)perylene	330U	330U	270J	110J	10U	10U
benzo(k)fluoranthene	330U	330U	390J	100J	10U	10U
bis(2-chloroethoxy)methane	330U	330U	920U	720U	10U	10U
bis(2-chloroethyl)ether	330U	330U	920U	720U	10U	10U
2,2'-oxybis(1-chloropropane)	330U	330U	920U	720U	10U	10U
bis(2-ethylhexyl)phthalate	330U	330U	180J	150J	32B	32B
4-bromophenylphenyl ether	330U	330U	920U	720U	10U	10U
butylbenzylphthalate	330U	330U	920U	720U	10U	10U
2-chloronaphthalene	330U	330U	920U	720U	10U	10U
4-chlorophenylphenyl ether	330U	330U	920U	720U	10U	10U
chrysene	330U	330U	540J	150J	10U	10U
dibenzo(a,h)anthracene	330U	330U	920U	720U	10U	10U
1,2-dichlorobenzene	330U	330U	920U	720U	10U	10U
1,3-dichlorobenzene	330U	330U	920U	720U	10U	10U
1,4-dichlorobenzene	330U	330U	920U	720U	10U	10U
3,3'-dichlorobenzidine	660U	660U	1800U	1400U	20U	20U
diethylphthalate	330U	330U	920U	720U	10U	10U
dimethylphthalate	330U	330U	920U	720U	10U	10U
di-n-butylphthalate	330U	330U	920U	74J	10U	10U
2,4-dinitrotoluene	330U	330U	920U	720U	10U	10U
2,6-dinitrotoluene	330U	330U	920U	720U	10U	10U
di-n-octylphthalate	330U	330U	920U	720U	10U	10U
1,2-diphenylhydrazine	330U	330U	920U	720U	10U	10U
fluoranthene	330U	330U	1100	240J	10U	10U
fluorene	330U	330U	920U	720U	10U	10U

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Site 2	Site 2 dup	Rinsate Blank	DI
priority pollutants - semivolatiles (ug/l)	91101	91301			51502	51502
hexachlorobenzene	330U	330U	920U	720U	10U	10U
hexachlorobutadiene	330U	330U	920U	720U	10U	10U
hexachlorocyclopentadiene	330U	330U	920U	720U	10U	10U
hexachlorethane	330U	330U	920U	720U	10U	10U
indeno(1,2,3-cd)pyrene	330U	330U	260J	720U	10U	10U
isophorone	330U	330U	920U	720U	10U	10U
naphthalene	330U	330U	920U	720U	10U	10U
nitrobenzene	330U	330U	920U	720U	10U	10U
n-nitrosodimethylamine	330U	330U	920U	720U	10U	10U
n-nitrosodi-n-propylamine	330U	330U	920U	720U	10U	10U
n-nitrosodiphenylamine	330U	330U	920U	720U	10U	10U
phenanthrene	330U	330U	850J	720U	10U	10U
pyrene	330U	330U	1000	260J	10U	10U
1,2,4-trichlorobenzene	330U	330U	920U	720U	10U	10U
2-chlorophenol	330U	330U	920U	720U	10U	10U
2,4-dichlorophenol	330U	330U	920U	720U	10U	10U
2,4-dimethylphenol	330U	330U	920U	720U	10U	10U
4,6-dinitro-2-methylphenol	1700U	1700U	4700U	3700U	50U	50U
2,4-dinitrophenol	1700U	1700U	4700U	3700U	50U	50U
2-nitrophenol	330U	330U	920U	720U	10U	10U
4-nitrophenol	1700U	1700U	4700U	3700U	50U	50U
4-chloro-3-methylphenol	330U	330U	920U	720U	10U	10U
pentachlorophenol	1700U	1700U	4700U	3700U	50U	50U
phenol	330U	330U	920U	720U	10U	10U
2,4,6-trichlorophenol	330U	330U	920U	720U	10U	10U
Chlorinated Pesticides (ug/l)						
aldrin	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
alpha-BHC	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
beta-BHC	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
gamma_BHC (lindane)	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
delta-BHC	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
chlordane	17U	17U	94U	74U	0.5U	0.5U
4,4'-DDD	3.3U	3.3U	18U	14U	0.1U	0.1U
4,4'-DDE	3.3U	3.3U	18U	14U	0.1U	0.1U
4,4'-DDT	3.3U	3.3U	18U	14U	0.1U	0.1U
dieldrin	3.3U	3.3U	18U	14U	0.1U	0.1U
endosulfan I	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
endosulfan II	3.3U	3.3U	18U	14U	0.1U	0.1U
endosulfan sulfate	3.3U	3.3U	18U	14U	0.1U	0.1U
endrin	3.3U	3.3U	18U	14U	0.1U	0.1U
endrin aldehyde	3.3U	3.3U	18U	14U	0.1U	0.1U
heptachlor	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U
heptachlor epoxide	1.7U	1.7U	9.4U	7.4U	0.05U	0.05U

toxaphene	170U	170U	940U	740U	5.0U	5.0U

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Site 2	Site 2 dup	Rinsate Blank	DI
PCBs (ug/l)	51602	51402			51502	51502
aroclor-1016	33U	33U	180U	140U	1.0U	1.0U
aroclor-1221	67U	67U	370U	290U	2.0U	2.0U
aroclor-1232	33U	33U	180U	140U	1.0U	1.0U
aroclor-1242	33U	33U	180U	140U	1.0U	1.0U
aroclor-1248	33U	33U	180U	140U	1.0U	1.0U
aroclor-1254	33U	33U	180U	140U	1.0U	1.0U
aroclor-1260	33U	33U	180U	140U	1.0U	1.0U
Priority Pollutant - Metals (ug/l)						
antimony	0.42B	2.0U	5.6UN	4.0UN	20U	20U
arsenic	0.50U	0.50U	11	12	5.0U	5.0U
beryllium	0.20U	0.20U	1.3	1.1	1.0U	1.0U
cadmium	0.20U	0.25B	28N	26N	5.0U	5.0U
chromium	0.090B	0.14B	22NE*	18NE*	3.0U	3.0U
copper	1.0U	0.16B	34E	27E	3.3B	3.2B
lead	5.0U	5.0U	22	19	10U	10U
nickel	5.0U	5.0U	2.8U	2.0U	5.0U	5.0U
selenium	-0.67B	1.0U	2.8U	2.0U	5.0U	5.0U
silver	1.0U	1.0U	2.8U	2.0U	10U	10U
thallium	1.0U	1.0U	120NE	100NE	10U	10U
zinc	0.20B	0.32B	0.33B	0.20B	1.2B	1.1B
mercury	0.020U	0.020U	0.047B	0.039	0.20U	0.20U
Phenolics, Total (mg/l)	1.0U	0.5U	4	1.9B	0.050U	0.050U
Cyanide, Total (mg/l)	1.0U	1.0U	2.8U	2.1U	0.010U	0.010U
Nitrate + Nitrite-N (mg/l)	N/A	N/A	N/A	N/A	0.050U	0.050U
ammonia as N (mg/l)	N/A	N/A	N/A	N/A	0.037	0.025B
Total Phosphorus (mg/l)	N/A	N/A	N/A	N/A	0.070B	0.10U
Total Kjeldahl Nitrogen-N (mg/l)	N/A	N/A	N/A	N/A	0.20U	0.20U
Total Organic Carbon (mg/l)	500U	500U	43000	36000	1.0U	1.0U
Acid Volatile Sulfide	10U	10U	330	390	N/A	N/A
Acid Volatile Sulfide Extractable Metals						
cadmium	0.072U	0.072U	0.19B	0.16	N/A	N/A
copper	-0.011B	-0.023B	7.1	5.2	N/A	N/A
nickel	0.058U	0.058U	3.6	3.2	N/A	N/A
zinc	0.23B	0.16B	45NE	38NE	N/A	N/A
lead	0.072U	0.072U	16E	13E	N/A	N/A
Grain Size	N/A	N/A			N/A	N/A
%gravel	N/A	N/A	13.0	7.1	N/A	N/A
%sand	N/A	N/A	42.4	40.7	N/A	N/A
%silt	N/A	N/A	33.0	39.4	N/A	N/A

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

%clay	N/A	N/A	11.6	12.8	N/A	N/A

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank 51602	Method Blank 51402	Site 2	Site 2 dup	Rinsate Blank 51502	DI 51502
Volatile Organic Compounds (ug/l)						
acrolein	100U	100U	250U	190U	20U	20U
acrylonitrile	100U	100U	250U	190U	20U	20U
benzene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
bromoform	5.0U	5.0U	13U	9.4U	1.0U	1.0U
carbon tetrachloride	5.0U	5.0U	13U	9.4U	1.0U	1.0U
chlorobenzene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
dibromochloromethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
chlorethane	10U	10U	25U	19U	1.0U	1.0U
2-chloroethylvinyl ether	50UJ	50UJ	130UJ	94UJ	10U	10U
chloroform	5.0U	5.0U	13U	9.4U	1.0U	1.0U
dichlorobromomethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,1-dichloroethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,2-dichloroethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,1-dichloroethene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,2-dichloropropane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,3-dichloropropylene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
ethylbenzene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
bromomethane	10U	10U	25U	19U	1.0U	1.0U
chloromethane	10U	10U	25U	19U	1.0U	1.0U
methylene chloride	5.0U	5.0U	13U	9.4U	5.0U	5.0U
1,1,2,2-tetrachloroethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
tetrachloroethene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
toluene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
trans-1,2-dichloroethene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,1,1-trichloroethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
1,1,2-trichloroethane	5.0U	5.0U	13U	9.4U	1.0U	1.0U
trichlorethene	5.0U	5.0U	13U	9.4U	1.0U	1.0U
vinyl chloride	10U	10U	25U	19U	1.0U	1.0U

B (inorganic) - reported value is < the Project Reporting Limit (PRL) but ≥ to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Trip Blank 51502	Trip Blank 51602	Site 02	Site 02-dup
Total Dissolved Solids (mg/l)	5.0U	5.0U	N/A	N/A	270	260
Suspended Solids (mg/l)	5.0U	5.0U	N/A	N/A	5.0U	5.0U
Hardness, Carbonate (mg/l)	10U	10U	N/A	N/A	260	260
priority pollutants - semivolatiles (ug/l)						
acenaphthene	10U	10U	N/A	N/A	10U	10U
acenaphthylene	10U	10U	N/A	N/A	10U	10U
anthracene	10U	10U	N/A	N/A	10U	10U
benzidine	80U	80U	N/A	N/A	80U	80U
benzo(a)anthracene	10U	10U	N/A	N/A	10U	10U
benzo(a)pyrene	10U	10U	N/A	N/A	10U	10U
benzo(b)fluoranthene	10U	10U	N/A	N/A	10U	10U
benzo(g,h,I)perylene	10U	10U	N/A	N/A	10U	10U
benzo(k)fluoranthene	10U	10U	N/A	N/A	10U	10U
bis(2-chloroethoxy)methane	10U	10U	N/A	N/A	10U	10U
bis(2-chloroethyl)ether	10U	10U	N/A	N/A	10U	10U
2,2'-oxybis(1-chloropropane)	10U	10U	N/A	N/A	10U	10U
bis(2-ethylhexyl)phthalate	10U	10U	N/A	N/A	10U	10U
4-bromophenylphenyl ether	10U	10U	N/A	N/A	10U	10U
butylbenzylphthalate	10U	10U	N/A	N/A	10U	10U
2-chloronaphthalene	10U	10U	N/A	N/A	10U	10U
4-chlorophenylphenyl ether	10U	10U	N/A	N/A	10U	10U
chrysene	10U	10U	N/A	N/A	10U	10U
dibenzo(a,h)anthracene	10U	10U	N/A	N/A	10U	10U
1,2-dichlorobenzene	10U	10U	N/A	N/A	10U	10U
1,3-dichlorobenzene	10U	10U	N/A	N/A	10U	10U
1,4-dichlorobenzene	10U	10U	N/A	N/A	10U	10U
3,3'-dichlorobenzidine	20U	20U	N/A	N/A	20U	20U
diethylphthalate	10U	10U	N/A	N/A	10U	10U
dimethylphthalate	10U	10U	N/A	N/A	10U	10U
di-n-butylphthalate	10U	10U	N/A	N/A	10U	10U
2,4-dinitrotoluene	10U	10U	N/A	N/A	10U	10U
2,6-dinitrotoluene	10U	10U	N/A	N/A	10U	10U
di-n-octylphthalate	10U	10U	N/A	N/A	10U	10U
1,2-diphenylhydrazine	10U	10U	N/A	N/A	10U	10U
fluoranthene	10U	10U	N/A	N/A	10U	10U
fluorene	10U	10U	N/A	N/A	10U	10U

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Trip Blank	Trip Blank	Site 02	Site 02-dup
priority pollutants - semivolatiles (ug/l)			51502	51602		
hexachlorobenzene	10U	10U	N/A	N/A	10U	10U
hexachlorobutadiene	10U	10U	N/A	N/A	10U	10U
hexachlorocyclopentadiene	10U	10U	N/A	N/A	10U	10U
hexachlorethane	10U	10U	N/A	N/A	10U	10U
indeno(1,2,3-cd)pyrene	10U	10U	N/A	N/A	10U	10U
isophorone	10U	10U	N/A	N/A	10U	10U
naphthalene	10U	10U	N/A	N/A	10U	10U
nitrobenzene	10U	10U	N/A	N/A	10U	10U
n-nitrosodimethylamine	10U	10U	N/A	N/A	10U	10U
n-nitrosodi-n-propylamine	10U	10U	N/A	N/A	10U	10U
n-nitrosodiphenylamine	10U	10U	N/A	N/A	10U	10U
phenanthrene	10U	10U	N/A	N/A	10U	10U
pyrene	10U	10U	N/A	N/A	10U	10U
1,2,4-trichlorobenzene	10U	10U	N/A	N/A	10U	10U
2-chlorophenol	10U	10U	N/A	N/A	10U	10U
2,4-dichlorophenol	10U	10U	N/A	N/A	10U	10U
2,4-dimethylphenol	10U	10U	N/A	N/A	10U	10U
4,6-dinitro-2-methylphenol	50U	50U	N/A	N/A	50U	50U
2,4-dinitrophenol	50U	50U	N/A	N/A	50U	50U
2-nitrophenol	10U	10U	N/A	N/A	10U	10U
4-nitrophenol	50U	50U	N/A	N/A	50U	50U
4-chloro-3-methylphenol	10U	10U	N/A	N/A	10U	10U
pentachlorophenol	50U	50U	N/A	N/A	50U	50U
phenol	10U	10U	N/A	N/A	10U	10U
2,4,6-trichlorophenol	10U	10U	N/A	N/A	10U	10U
Chlorinated Pesticides (ug/l)						
aldrin	0.05U	0.05U	N/A	N/A	0.05U	0.05U
alpha-BHC	0.05U	0.05U	N/A	N/A	0.05U	0.05U
beta-BHC	0.05U	0.05U	N/A	N/A	0.05U	0.05U
gamma_BHC (lindane)	0.05U	0.05U	N/A	N/A	0.05U	0.05U
delta-BHC	0.05U	0.05U	N/A	N/A	0.05U	0.05U
chlordane	0.5U	0.5U	N/A	N/A	0.5U	0.5U
4,4'-DDD	0.1U	0.1U	N/A	N/A	0.1U	0.1U
4,4'-DDE	0.1U	0.1U	N/A	N/A	0.1U	0.1U
4,4'-DDT	0.1U	0.1U	N/A	N/A	0.1U	0.1U
dieldrin	0.1U	0.1U	N/A	N/A	0.1U	0.1U
endosulfan I	0.05U	0.05U	N/A	N/A	0.05U	0.05U
endosulfan II	0.1U	0.1U	N/A	N/A	0.1U	0.1U
endosulfan sulfate	0.1U	0.1U	N/A	N/A	0.1U	0.1U
endrin	0.1U	0.1U	N/A	N/A	0.1U	0.1U
endrin aldehyde	0.1U	0.1U	N/A	N/A	0.1U	0.1U
heptachlor	0.05U	0.05U	N/A	N/A	0.05U	0.05U
heptachlor epoxide	0.05U	0.05U	N/A	N/A	0.05U	0.05U

toxaphene	5.0U	5.0U	N/A	N/A	5.0U	5.0U

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Trip Blank 51502	Trip Blank 51602	Site 02	Site 02-dup
PCBs (ug/l)						
aroclor-1016	1.0U	1.0U	N/A	N/A	1.0U	1.0U
aroclor-1221	2.0U	2.0U	N/A	N/A	2.0U	2.0U
aroclor-1232	1.0U	1.0U	N/A	N/A	1.0U	1.0U
aroclor-1242	1.0U	1.0U	N/A	N/A	1.0U	1.0U
aroclor-1248	1.0U	1.0U	N/A	N/A	1.0U	1.0U
aroclor-1254	1.0U	1.0U	N/A	N/A	1.0U	1.0U
aroclor-1260	1.0U	1.0U	N/A	N/A	1.0U	1.0U
Priority Pollutant - Metals (ug/l)						
antimony	20U	20U	N/A	N/A	20U	20U
arsenic	5.0U	5.0U	N/A	N/A	5.0U	5.0U
beryllium	1.0U	1.0U	N/A	N/A	1.0U	1.0U
cadmium	5.0U	5.0U	N/A	N/A	5.0U	5.0U
chromium	3.0U	3.0U	N/A	N/A	3.0U	3.0U
copper	2.1B	2.5B	N/A	N/A	3.3B	3.7B
lead	10U	10U	N/A	N/A	10U	10U
nickel	5.0U	5.0U	N/A	N/A	5.0U	5.0U
selenium	5.0U	5.0U	N/A	N/A	5.0U	5.0U
silver	10U	10U	N/A	N/A	10U	10U
thallium	10U	10U	N/A	N/A	10U	10U
zinc	10U	10U	N/A	N/A	2.2B	2.2B
mercury	0.20U	0.20U	N/A	N/A	0.20U	0.20U
Phenolics, Total (mg/l)	0.050U	0.050U	N/A	N/A	0.050U	0.050U
Cyanide, Total (mg/l)	0.010U	0.010U	N/A	N/A	0.010U	0.010U
Nitrate + Nitrite-N (mg/l)	0.050U	0.050U	N/A	N/A	0.5	0.49
ammonia as N (mg/l)	0.030U	0.030U	N/A	N/A	0.026B	0.031
Total Phosphorus (mg/l)	0.01U	0.01U	N/A	N/A	0.10U	0.10U
Total Kjeldahl Nitrogen-N (mg/l)	0.20U	0.20U	N/A	N/A	0.13B	0.19B
Total Organic Carbon (mg/l)	1.0U	1.0U	N/A	N/A	1.3	1.1
Acid Volatile Sulfide						
Acid Volatile Sulfide Extractable Metals						
cadmium						
copper						
nickel						
zinc						
lead						
Grain Size						
%gravel						
%sand						
%silt						

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

%clay

Quality assurance/quality control results for the May 2002 sampling in the Indian Creek watershed, Tazewell County, Virginia

	Method Blank	Method Blank	Trip Blank 51502	Trip Blank 51602	Site 02	Site 02-dup
Volatile Organic Compounds (ug/l)						
acrolein	20U	20U	20U	20U	20U	20U
acrylonitrile	20U	20U	20U	20U	20U	20U
benzene	1.0U	1.0U	1.0U	.22J	1.0U	1.0U
bromoform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
carbon tetrachloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorobenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dibromochloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chlorethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
2-chloroethylvinyl ether	10U	10U	10U	10U	10U	10U
chloroform	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
dichlorobromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,2-dichloropropane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,3-dichloropropylene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
ethylbenzene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
bromomethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
chloromethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
methylene chloride	5.0U	5.0U	5.0U	5.0U	5.0U	5.0U
1,1,2,2-tetrachloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
tetrachloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
toluene	1.0U	1.0U	.56J	1.0U	1.0U	1.0U
trans-1,2-dichloroethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,1-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
1,1,2-trichloroethane	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
trichlorethene	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
vinyl chloride	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U

B (inorganic) - reported value is less than the Project Reporting Limit (PRL) but greater than or equal to the Method Detection Limit (MDL)
N (inorganic) - spiked sample recovery is not within control limits
E (inorganic) - reported value is estimated because of the presence of interference
J - presence of a compound meets the identification criteria, but the result is less than the PRL and greater than the MDL
U - concentration below Project Reporting Limit
P - identification of target analyte using GC methodology is based on the retention time. Although two dissimilar GC columns confirmed the presence of the target analyte in the sample, relative percent difference is >40%
* - duplicate analysis not within control limits.

Table 1. Indian Creek watershed, Tazewell County, Virginia sampling locations for benthic macroinvertebrate surveys.

Site	Stream Name	Description of Location	Latitude	Longitude	Date Sampled
1	Indian Creek	Behind the trailer park off 631.	37 05 26.88	81 44 38.44	02.25.02
2	Lowe Branch	Downstream of the old gas station in Busthead.	37 06 28.66	81 41 58.44	02.26.02
3	Lowe Branch	On property of Mary Barnett.	37 06 29.71	81 41 06.67	02.26.02
4	NNT to Lowe Branch	Approximately 0.5 miles northwest of 636/627 intersection on 627.	37 06 58.43	81 42 12.73	02.26.02
5	Indian Creek	Downstream of confluence with Lowe Branch, upstream of RR trestle on dirt road.	37 06 51.24	81 43 05.18	02.26.02
6	Laurel Fork	Upstream of first bridge on downstream end of Laurel Fork.	37 07 14.67	81 42 49.40	02.26.02
7	Laurel Fork	Upstream of the bridge off of 626, on Bandy Sportsmen’s Club property.	37 07 50.03	81 43 02.09	02.26.02
8	Indian Creek	Past Bandy, upstream of Panther Branch, upstream of the 627 bridge.	37 08 54.92	81 42 09.92	02.27.02
9	Greasy Creek	On Consolidation Coal Co. property off Rt 612.	37 10 41.89	81 44 10.47	02.27.02
10	Greasy Creek	Further downstream than station 9, on Consol property.	37 09 38.04	81 42 53.58	02.27.02
11	Indian Creek	In Harman.	37 09 32.12	81 42 28.51	02.27.02
12	Jackson Fork	Upstream of the 627 bridge.	37 10 48.82	81 42 20.30	02.27.02
13	Indian Creek	Upstream of Jackson Fork.	37 11 06.36	81 42 49.91	02.28.02
14	North Branch of Indian Creek	On Knox Creek Coal property.	37 11 58.00	81 42 58.51	N/S
15	South Branch of Indian Creek	On AT Massey property.	37 11 51.47	81 43 05.26	02.28.02
16	Indian Creek	Downstream of Jackson Fork, and upstream of Harman.	37 10 26.59	81 42 37.25	02.28.02
17	Panther Branch	Approximately 20 meters upstream of confluence with Indian Creek.	37 08 43.94	81 42 11.28	02.27.02
18	Indian Creek	South of Bandy, downstream of the RR bridge.	37 07 45.67	81 41 58.34	02.26.02
19	Coal Branch	Upstream of RR tunnel.	37 07 56.17	81 41 54.71	02.26.02
20	Raven Nest Branch	Upstream of RR tunnel.	37 06 06.59	81 44 08.16	02.28.02
21	Indian Creek	At Cedar Bluff, along 631.	37 05 17.37	81 45 19.67	02.26.02
22	North Branch of Indian Creek	Upstream of site 14, near gas well.	37 12 41.56	81 43 07.73	N/S
23	North Branch of Indian Creek	Between sites 14 and 22.	37 12 10.86	81 42 53.81	02.28.02

NS - not sampled due to beaver impoundments
Watershed and sites are located on the Amonate, Jewell Ridge, Pounding Mill and Richlands VA 7.5 minute USGS topographic maps.

Periphyton survey locations, Indian Creek, Tazewell, Virginia

Site 1. 37005.558N latitude; 81044.641W longitude.
Site 2. 37006.475N latitude; 81041.975W longitude.
Site 3. 37006.469N latitude; 81041.253W longitude.
Site 4. 37006.998N latitude; 81042.270W longitude.
Site 5. 37006.853N latitude; 81043.113W longitude.
Site 6. 37007.279N latitude; 81042.778W longitude.
Site 7. 37007.836N latitude; 81043.044W longitude.
Site 8. 37008.929N latitude; 81042.198W longitude.
Site 9. 37010.708N latitude; 81044.157W longitude.
Site 10. 37009.639N latitude; 81042.911W longitude.
Site 11. 37009.524N latitude; 81042.452W longitude.
Site 12. 37010.822N latitude; 81042.338W longitude.
Site 13. 37011.124N latitude; 81042.778W longitude.
Site 14. 37011.897N latitude; 81042.989W longitude.
Site 15. 37011.860N latitude; 81043.080W longitude.
Site 16. 37010.368N latitude; 81042.586W longitude.
Site 17. 37008.728N latitude; 81042.174W longitude.
Site 18. 37007.787N latitude; 81041.983W longitude.
Site 19. 37007.957N latitude; 81041.914W longitude.
Site 20. 37006.118N latitude; 81044.134W longitude.
Site 21. 37006.116N latitude; 81044.134W longitude.
Site 22. 37011.216N latitude; 81042.832W longitude.

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 1 No/mm²	SITE 1 biovol mm³/mm²	SITE 2 No/mm²	SITE 2 biovol mm³/mm²	SITE 3 No/mm²	SITE 3 biovol mm³/mm²	SITE 4 No/mm²	SITE 4 biovol mm³/mm²	SITE 5 No/mm²	SITE 5 biovol mm³/mm²	SITE 6 No/mm²	SITE 6 biovol mm³/mm²
CHLOROPHYTA													
Chlorococcales													
Oocystaceae													
Closteriopsis sp.													
Scendesmaceae													
Scenedusmus quadricauda		1.02	1										
Ulotrichales													
Microsporaceae													
Microspora sp.		70.38	57	0.14	0	0.168	0			0.231	0		
Ulotrichaceae													
Ulothrix sp.													
Chaetophorales													
Chaetophoraceae													
Stigeoclonium sp.													
Oedogoniales													
Oedogoniaceae													
Oedogonium sp.													
Siphonocladales													
Cladophoraceae													
Cladophora sp.		19.38	572	0.518	15	1.05	31	0.1239	4	0.735	22	4.655	137
Zygnematales													
Zygnemataceae													
Mougeotia sp.		5.1	5										
Desmidiaceae													
Closterium sp.		4.08	196	0.014	1					0.035	2	1.33	64
Euastrum sp.												0.665	6
CHRYSOPHYTA													
Bacillariophyceae													
Centrales													
Cosinodiscaeceae													
Melosira varians	2	12.75	37			0.063	0					99.75	42
Pennales													
Fragilariaceae													

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 1		SITE 2		SITE 3		SITE 4		SITE 5		SITE 6	
		No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
Diatoma vulgare	3	5.1	11	0.063	0	0.084	0			0.021	0	7.98	3
Synedra ulna	3					0.021	0					17.29	8
Eunotiaceae													
Eunotia sp.	3												
Achnanthaceae													
Achnanthes lanceolata	3	8.16	2	0.707	0			0.0301	0	0.385	0	32.585	1
Cocconeis placentula	3	7.14	47	0.469	0	0.21	0	0.0161	0	0.175	0		
Rhoicosphenia curvata	3			0.042	0	0.434	0	0.0021	0	0.098	0		
Naviculaceae													
Amphipleura pellucida	3	1.53	1										
Gyrosigma sp.	3	13.26	36	0.056	0	0.021	0						
Frustulia rhomboides	3	10.2	65	0.014	0								
Navicula sp.		36.21	61	0.175	0	0.126	0	0.0042	0	0.231	0	18.62	5
Navicula radiosa	3	6.63	11			0.028	0					7.98	2
Pinnularia sp.		0.51	2										
Gomphonemaceae													
Gomphonema constrictum						0.014	0						
Gomphonema angustrum	2	12.24	15	0.056	0	0.14	0	0.0056	0	0.301	0	25.935	24
Gomphoneis herculeana		2.04	3									3.99	4
Cymbellaceae													
Amphora ovalis	3							0.0105	0				
Cymbella sp.	3	7.65	49	0.252	0	0.07	0	0.0168	0	0.441	0		
Cymbella prostrata	3	5.1	32										
Cymbella tumida	3	22.95	146									57.19	70
Cymbella turgida	3									0.441	0		
Nitzschiaceae													
Nitzschia sp.	3	1.53	1	0.336	0	0.161	0			0.21	0		
Nitzschia dissipata	3	3.57	2			0.028	0					16.625	3
Nitzschia filiformis	1	1.53	1			0.063	0	0.0028	0			16.625	3
Nitzschia linearis	3					0.07	0						
Nitzschia sigmoida	3					0.042	0						
Surirellaceae													
Cymatopleura solea	3					0.007	0						
Surirella angustra	2	0.51	8			0.014	0						

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 1 No/mm^2	SITE 1 biovol mm^3/mm^2	SITE 2 No/mm^2	SITE 2 biovol mm^3/mm^2	SITE 3 No/mm^2	SITE 3 biovol mm^3/mm^2	SITE 4 No/mm^2	SITE 4 biovol mm^3/mm^2	SITE 5 No/mm^2	SITE 5 biovol mm^3/mm^2	SITE 6 No/mm^2	SITE 6 biovol mm^3/mm^2
Surirella ovata	2	1.02	6			0.07	0						
CYANOPHYTA													
Oscillatoriales													
Oscillatoriaceae													
Oscillatoria sp.		6.12	17	0.042	0	0.021	0	0.3402	1	0.665	3	0.665	3
Nostocales													
Nostocaceae													
Anabaena sp.													
***ROTIFERA**		3.06		0.028								2.66	
Ploima													
Brachionidae													
Keratella chochlearis													
Synchaetidae													
Polyarthra sp.													
Trichocercidae													
Trichocerca sp.													
TOTAL NO. OF ORGANISMS		**268.77**	**1383**	**2.912**	**16.863**	**2.905**	**31.516**	**0.5523**	**5.1601**	**3.969**	**26.668**	**314.545**	**375.4**
TOTAL NO. OF TAXA		**26**	**26**	**14**	**14**	**22**	**22**	**10**	**10**	**13**	**13**	**15**	**15**
TOTAL BIOVOLUME mm^3/mm^2			**1383**		**17**		**32**		**5**		**27**		**375**
*Not included in analyses													

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 7		SITE 8		SITE 9		SITE 10		SITE 11		SITE 12	
		No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
CHLOROPHYTA													
Chlorococcales													
Oocystaceae													
Closteriopsis sp.													
Scendesmaceae													
Scenedusmus quadricauda				0.035	0								
Ulotrichales													
Microsporaceae													
Microspora sp.				0.245	0	0.259	0					1.057	1
Ulotrichaceae													
Ulothrix sp.												0.056	0
Chaetophorales													
Chaetophoraceae													
Stigeoclonium sp.													
Oedogoniales													
Oedogoniaceae													
Oedogonium sp.													
Siphonocladales													
Cladophoraceae													
Cladophora sp.		53.2	1570	2.639	78	3.255	96					0.994	29
Zygnematales													
Zygnemataceae													
Mougeotia sp.						0.28	0					0.287	0
Desmidiaceae													
Closterium sp.													
Euastrum sp.													
CHRYSOPHYTA													
Bacillariophyceae													
Centrales													
Cosinodiscaeceae													
Melosira varians	2												
Pennales													
Fragilariaceae													

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 7		SITE 8		SITE 9		SITE 10		SITE 11		SITE 12	
		No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
Diatoma vulgare	3	1.33	1	0.007	0	0.049	0					0.42	0
Synedra ulna	3	6.65	5	0.126	0	0.091	0	0.035	0	0.888	1	0.448	0
Eunotiaceae													
Eunotia sp.	3					0.028	0	0.007	0	0.222	0		
Achnanthaceae													
Achnanthes lanceolata	3	17.955	0	0.119	0	2.751	0	0.161	0	82.14	2	1.96	0
Cocconeis placentula	3			0.042	0					1.332	0	0.511	0
Rhoicosphenia curvata	3	1.33	0	0.042	0								
Naviculaceae													
Amphipleura pellucida	3												
Gyrosigma sp.	3			0.014	0	0.028	0						
Frustulia rhomboides	3	3.325	14			0.021	0					0.028	0
Navicula sp.		17.955	1			1.4	1	0.112	0	0.444	0	1.344	0
Navicula radiosa	3	13.3	1	0.028	0								
Pinnularia sp.						0.056	0	0.007	0				
Gomphonemaceae													
Gomphonema constrictum													
Gomphonema angustrum	2	25.935	7	0.098	0			0.056	0	4.884	2	0.392	0
Gomphoneis herculeana													
Cymbellaceae													
Amphora ovalis	3												
Cymbella sp.	3	39.9	42	0.112	0	1.316	1			0.666	0	0.56	1
Cymbella prostrata	3	2.66	3										
Cymbella tumida	3	43.225	46										
Cymbella turgida	3							0.133	0				
Nitzschiaceae													
Nitzschia sp.	3			0.028	0	0.126	0	0.091	0			0.616	0
Nitzschia dissipata	3												
Nitzschia filiformis	1	19.95	1										
Nitzschia linearis	3	13.3	1										
Nitzschia sigmoida	3												
Surirellaceae													
Cymatopleura solea	3												

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 7 No/mm^2	SITE 7 biovol mm^3/mm^2	SITE 8 No/mm^2	SITE 8 biovol mm^3/mm^2	SITE 9 No/mm^2	SITE 9 biovol mm^3/mm^2	SITE 10 No/mm^2	SITE 10 biovol mm^3/mm^2	SITE 11 No/mm^2	SITE 11 biovol mm^3/mm^2	SITE 12 No/mm^2	SITE 12 biovol mm^3/mm^2
Surirella angustra	2												
Surirella ovata	2												
CYANOPHYTA													
Oscillatoriales													
Oscillatoriaceae													
Oscillatoria sp.						0.112	0			0.444	2	1.68	7
Nostocales													
Nostocaceae													
Anabaena sp.													
***ROTIFERA**						0.014							
Ploima													
Brachionidae													
Keratella chochlearis													
Synchaetidae													
Polyarthra sp.													
Trichocercidae													
Trichocerca sp.													
TOTAL NO. OF ORGANISMS		**260.02**	**1693.1**	**3.535**	**78.204**	**9.786**	**98.921**	**0.602**	**0.1327**	**91.02**	**6.7921**	**10.353**	**39.963**
TOTAL NO. OF TAXA		**14**	**14**	**13**	**13**	**14**	**14**	**8**	**8**	**8**	**8**	**14**	**14**
TOTAL BIOVOLUME mm^3/mm^2			**1693**		**78**		**99**		**0**		**7**		**40**
*Not included in analyses													

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 13 No/mm^2	SITE 13 biovol mm^3/mm^2	SITE 14 No/mm^2	SITE 14 biovol mm^3/mm^2	SITE 15 No/mm^2	SITE 15 biovol mm^3/mm^2	SITE 16 No/mm^2	SITE 16 biovol mm^3/mm^2	SITE 17 No/mm^2	SITE 17 biovol mm^3/mm^2	SITE 18 No/mm^2	SITE 18 biovol mm^3/mm^2
CHLOROPHYTA													
Chlorococcales													
Oocystaceae													
Closteriopsis sp.						0.532	0						
Scendesmaceae													
Scenedusmus quadricauda													
Ulotrichales													
Microsporaceae													
Microspora sp.		7.958	6							0.03	0		
Ulotrichaceae													
Ulothrix sp.													
Chaetophorales													
Chaetophoraceae													
Stigeoclonium sp.													
Oedogoniales													
Oedogoniaceae													
Oedogonium sp.						35.644	809						
Siphonocladales													
Cladophoraceae													
Cladophora sp.		7.093	209	1.098	32	6.384	188			0.102	3		
Zygnematales													
Zygnemataceae													
Mougeotia sp.						2.66	2						
Desmidiaceae													
Closterium sp.		0.692	33	0.054	3	2.66	128	0.007	0	0.021	1	35	1684
Euastrum sp.													
CHRYSOPHYTA													
Bacillariophyceae													
Centrales													
Cosinodiscaeceae													
Melosira varians	2												
Pennales													
Fragilariaceae													

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 13		SITE 14		SITE 15		SITE 16		SITE 17		SITE 18	
		No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
Diatoma vulgare	3			7.695	17	4.256	2						
Synedra ulna	3	1.557	0	0.414	0	39.9	16	0.077	0	0.006	0		
Eunotiaceae													
Eunotia sp.	3			0.243	0	2.128	0						
Achnanthaceae													
Achnanthes lanceolata	3	60.204	0	4.725	0	65.436	1	0.189	0	0.18	0	346.62	
Cocconeis placentula	3			0.027	0			0.084	0	0.042	0	5.3	
Rhoicosphenia curvata	3	0.519	0							0.015	0	5.3	
Naviculaceae													
Amphipleura pellucida	3												
Gyrosigma sp.	3												
Frustulia rhomboides	3												
Navicula sp.		5.19	3	0.918	0	6.384	2			0.399	0	4.24	
Navicula radiosa	3												
Pinnularia sp.				0.081	0	5.852	4						
Gomphonemaceae													
Gomphonema constrictum													
Gomphonema angustrum	2	14.013	4	0.387	0	15.96	1					8.48	
Gomphoneis herculeana													
Cymbellaceae													
Amphora ovalis	3												
Cymbella sp.	3	42.558	37	0.36	1	112.252	150	0.007	0	0.078	0	5.3	3
Cymbella prostrata	3												
Cymbella tumida	3												
Cymbella turgida	3												
Nitzschiaceae													
Nitzschia sp.	3	1.73	0	0.621	0	25.004	3			0.441	0	6.36	0
Nitzschia dissipata	3												
Nitzschia filiformis	1												
Nitzschia linearis	3												
Nitzschia sigmoida	3												
Surirellaceae													
Cymatopleura solea	3												

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 13 No/mm²	SITE 13 biovol mm³/mm²	SITE 14 No/mm²	SITE 14 biovol mm³/mm²	SITE 15 No/mm²	SITE 15 biovol mm³/mm²	SITE 16 No/mm²	SITE 16 biovol mm³/mm²	SITE 17 No/mm²	SITE 17 biovol mm³/mm²	SITE 18 No/mm²	SITE 18 biovol mm³/mm²
Surirella angustra	2												
Surirella ovata	2					1.064	1			0.024	0		
CYANOPHYTA													
Oscillatoriales													
Oscillatoriaceae													
Oscillatoria sp.		1.384	6	0.108	0					0.018	0	4.24	18
Nostocales													
Nostocaceae													
Anabaena sp.		0.519	0										
***ROTIFERA**													
Ploima													
Brachionidae													
Keratella chochlearis													
Synchaetidae													
Polyarthra sp.													
Trichocercidae													
Trichocerca sp.													
TOTAL NO. OF ORGANISMS		**143.417**	**299.64**	**16.731**	**54.731**	**326.116**	**1308.9**	**0.364**	**0.3821**	**1.356**	**4.4433**	**420.84**	**1705.1**
TOTAL NO. OF TAXA		**12**	**12**	**13**	**13**	**15**	**15**	**5**	**5**	**12**	**12**	**9**	**4**
TOTAL BIOVOLUME mm³/mm²			**300**		**55**		**1309**		**0**		**4**		**1705**

*Not included in analyses

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

SPECIES	Total Volume	SITE 19 No/mm^2	SITE 19 biovol mm^3/mm^2	SITE 20 No/mm^2	SITE 20 biovol mm^3/mm^2	SITE 21 No/mm^2	SITE 21 biovol mm^3/mm^2	SITE 22 No/mm^2	SITE 22 biovol mm^3/mm^2
CHLOROPHYTA									
Chlorococcales									
Oocystaceae									
Closteriopsis sp.									
Scendesmaceae									
Scenedusmus quadricauda				0.055	0	2.96	2	2.96	2
Ulotrichales									
Microsporaceae									
Microspora sp.				0.225	0	4.144	3		
Ulotrichaceae									
Ulothrix sp.									
Chaetophorales									
Chaetophoraceae									
Stigeoclonium sp.						31.968	3	8.88	1
Oedogoniales									
Oedogoniaceae									
Oedogonium sp.									
Siphonocladales									
Cladophoraceae									
Cladophora sp.						1.184	35		
Zygnematales									
Zygnemataceae									
Mougeotia sp.									
Desmidiaceae									
Closterium sp.									
Euastrum sp.									
CHRYSOPHYTA									
Bacillariophyceae									
Centrales									
Cosinodiscaeceae									
Melosira varians	2								
Pennales									
Fragilariaceae									

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

		SITE 19		SITE 20		SITE 21		SITE 22	
SPECIES	Total Volume	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
Diatoma vulgare	3					8.88	4		
Synedra ulna	3	0.049	0			5.92			
Eunotiaceae									
Eunotia sp.	3							26.048	1
Achnanthaceae									
Achnanthes lanceolata	3	1.008	0	0.555	0	71.04	2	29.6	0
Cocconeis placentula	3	0.112	0	0.355	0	30.192	14		
Rhoicosphenia curvata	3	1.904	0	1.625	0	1.184	0		
Naviculaceae									
Amphipleura pellucida	3								
Gyrosigma sp.	3			0.16	0				
Frustulia rhomboides	3								
Navicula sp.		1.456	0	8.1	3	4.144	1	5.328	0
Navicula radiosa	3								
Pinnularia sp.									
Gomphonemaceae									
Gomphonema constrictum									
Gomphonema angustrum	2			0.28	0	50.912	4	67.488	2
Gomphoneis herculeana									
Cymbellaceae									
Amphora ovalis	3								
Cymbella sp.	3	0.035	0	0.655	0	68.08	9	2.368	0
Cymbella prostrata	3								
Cymbella tumida	3								
Cymbella turgida	3								
Nitzschiaceae									
Nitzschia sp.	3	0.56	0	0.52	0	4.144	1		
Nitzschia dissipata	3								
Nitzschia filiformis	1								
Nitzschia linearis	3								
Nitzschia sigmoida	3								
Surirellaceae									
Cymatopleura solea	3								

Algae species, Indian Creek watershed, Tazewell, Virginia, July 25, 2001

		SITE 19		SITE 20		SITE 21		SITE 22	
SPECIES	Total Volume	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2	No/mm^2	biovol mm^3/mm^2
Surirella angustra	2								
Surirella ovata	2			0.2	1				
CYANOPHYTA									
Oscillatoriales									
Oscillatoriaceae									
Oscillatoria sp.				0.25	1				
Nostocales									
Nostocaceae									
Anabaena sp.									
***ROTIFERA**									
Ploima									
Brachionidae									
Keratella chochlearis									
Synchaetidae									
Polyarthra sp.									
Trichocercidae									
Trichocerca sp.									
TOTAL NO. OF ORGANISMS		**5.124**	**0.706**	**12.98**	**6.0207**	**284.752**	**78.223**	**142.672**	**6.2511**
TOTAL NO. OF TAXA		**7**	**7**	**12**	**12**	**13**	**12**	**7**	**7**
TOTAL BIOVOLUME mm^3/mm^2			**1**		**6**		**78**		**6**
*Not included in analyses									

Fish species lists, Indian Creek watershed, Tazewell, Virginia, September 2001

Species	**Sites===>**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Mountain brook lampey	Ichthyomyzon greeleyi								11					
Central stoneroller	Campostoma anomalum	438	14		2	132	448	13	41			48	2	46
Rosyside dace	Clinostomus funduloides							10		17	32		13	15
Whitetail shiner	Cyprinella galactura	43				11			3					
Bigeye chub	Hybopsis amblops	12				1	12		275			20		
Striped shiner	Luxilus chrysocephalus	72				59	37	21	18			46		
Warpaint shiner	Luxilus coccogenis	71				103	43	1				1		
Mountain shiner	Lythrurus lirus	6				33								
River chub	Nocomis micropogon	18				8								
Tennessee shiner	Notropis leuciodus	19				28								
Mirror shiner	Notropis spectrunculus					10	13		2			12		
Telescope shiner	Notropis telescopus	1				269	45		100		4	12		
Sawfin shiner	Notropis (undescribed)	16				10	5		39			2		
Laurel dace	Phoxinus sp., cf. saylori									9				
Bluntnose minnow	Pimephales notatus	28				3	5		76			19		
Fathead minnow	Pimephales promelas				45									
Blacknose dace	Rhinichthys atratulus	1	63	88	115	14	96	112	15	46	90	98	133	237
Creek chub	Semotilus atromaculatus		10	9	5		29	36	4	85	41	49	17	24
White sucker	Catostomus commersoni	5			2		12	6		46	7	4		3
Northern hog sucker	Hypentelium nigricans	15				2	1		24			14		
Black redhorse	Moxostoma duquesnei	2				1								
Rainbow trout	Onchorhynchus mykiss	1												
Brown trout	Salmo trutta							1						
Yellow bullhead	Ameiurus natalis													
Northern studfish	Fundulus catenatus	2												
Clinch sculpin	Cottus sp.	19			4	4								
Rock bass	Ambloplites rupestris	7	5	21		9	1		12			4		
Redbreast sunfish	Lepomis auritus	10		5					13			2		
Smallmouth bass	Micropterus dolomieu	3							7			3		
Largemouth bass	Micropterus salmoides	2												
Greenside darter	Etheostoma blennioides	13				3			2					
Fantail darter	Etheostoma flabellare	5			6	5	49	34	20	4	2	6	18	39
Redline darter	Etheostoma rufilineatum	6				19	7		15					
Snubnose darter	Etheostoma simoterum	9				10			19			3		1
Speckled darter	Etheostoma stigmaeum	1				6			17			5		
Banded darter	Etheostoma zonale	1												
	Total	**826**	**92**	**123**	**179**	**740**	**803**	**234**	**713**	**207**	**176**	**348**	**183**	**365**
	No. of species	**28**	**4**	**4**	**7**	**22**	**15**	**9**	**20**	**6**	**6**	**18**	**5**	**7**

Fish species lists, Indian Creek watershed, Tazewell, Virginia, September 2001

14	15	16	17	18	19	20	21	22	Totals	Species	
							N		**11**	Mountain brook lampey	Ichthyomyzon greeleyi
	1	9		136	6	4	**O**		**1340**	Central stoneroller	Campostoma anomalum
47					1			11	**146**	Rosyside dace	Clinostomus funduloides
				20			**S**		**77**	Whitetail shiner	Cyprinella galactura
		2		22			**A**		**344**	Bigeye chub	Hybopsis amblops
		26		71	3		**M**		**353**	Striped shiner	Luxilus chrysocephalus
		1		1			**P**		**221**	Warpaint shiner	Luxilus coccogenis
				2			**L**		**41**	Mountain shiner	Lythrurus lirus
				1			**E**		**27**	River chub	Nocomis micropogon
							S		**47**	Tennessee shiner	Notropis leuciodus
		6		9	1				**53**	Mirror shiner	Notropis spectrunculus
		36		88		4			**559**	Telescope shiner	Notropis telescopus
		5		28					**105**	Sawfin shiner	Notropis (undescribed)
8	16							6	**39**	Laurel dace	Phoxinus sp., cf. saylori
		52		10					**193**	Bluntnose minnow	Pimephales notatus
									45	Fathead minnow	Pimephales promelas
49	37	27	71	61	68	40		42	**1503**	Blacknose dace	Rhinichthys atratulus
83	19	24	9	5	36	5		95	**585**	Creek chub	Semotilus atromaculatus
16		6		1	3			16	**127**	White sucker	Catostomus commersoni
		4		9					**69**	Northern hog sucker	Hypentelium nigricans
									3	Black redhorse	Moxostoma duquesnei
									1	Rainbow trout	Onchorhynchus mykiss
									1	Brown trout	Salmo trutta
								2	**2**	Yellow bullhead	Ameiurus natalis
									2	Northern studfish	Fundulus catenatus
									27	Clinch sculpin	Cottus sp.
		13		8				4	**84**	Rock bass	Ambloplites rupestris
		2							**32**	Redbreast sunfish	Lepomis auritus
		3		1					**17**	Smallmouth bass	Micropterus dolomieu
					1				**3**	Largemouth bass	Micropterus salmoides
				8					**26**	Greenside darter	Etheostoma blennioides
15	4	15		24	6			11	**263**	Fantail darter	Etheostoma flabellare
				20					**67**	Redline darter	Etheostoma rufilineatum
		6		11					**59**	Snubnose darter	Etheostoma simoterum
		1		2					**32**	Speckled darter	Etheostoma stigmaeum
									1	Banded darter	Etheostoma zonale
218	**77**	**238**	**80**	**538**	**125**	**53**	**NS**	**187**	**6505**		
6	**5**	**18**	**2**	**22**	**9**	**4**	**NS**	**8**			

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 1
Drainage area: 32.8 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<12	12 - 22	>22	26	5
Number of darter species	<3	3 - 4	>4	6	5
Number of sunfish species, excluding *Micropterus* species	<2	2	>2	1	1
Number of sucker species	<2	2	>2	3	5
Number of intolerant species	<2	2-3	>3	5	5
Percentage of tolerant species	>31	16 - 31	<16	2	5
species	>37	19 - 37	<19	67.9	1
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<21	21 - 40	>40	19.6	1
Percentage of individuals as piscivores*	<2	2 - 4	>4	1.5	1
Catch rate (number of fish per 300 sq. ft.)	<19.5	19.5 - 38.9	38.9	39	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	2	3
Minimun Catch rate required: 9.8					42 fair

Site 2
Drainage area: 2.24 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<4	4 - 6	>6	4	3
Number of riffle species	<2	2	>2	0	1
Number of pool species	<3	3 - 5	>5	2	1
Percent individuals of two dominant species	>86	74 - 86	<74	83.7	3
Number of headwater intolerant species	<2	2	>2	0	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	15.2	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<9	9-17	>17	0	1
Percentage of individuals as piscivores*	<1		>0	5.4	5
Catch rate (number of fish per 300 sq. ft.)	<40.3	40.3 - 80.4	>80.4	40.3	3
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	68.5	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2-5	<2	2	3
*Miniumum catch rate required: 20.2					36 poor/fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 3
Drainage area: 1.44 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<3	3 - 4	>4	3	3
Number of riffle species	<1	1	>1	0	1
Number of pool species	<1		>0	2	1
Percent individuals of two dominant species	>88	77 - 88	<77	88.6	1
Number of headwater intolerant species	<1	1	>1	0	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	0	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<7	7 - 13	>13	0	1
Percentage of individuals as piscivores*	<1		>0	17.4	5
Catch rate (number of fish per 300 sq. ft.)	<45.4	45.4 - 90.6	>90.6	45.4	3
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	71.5	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2-5	<2	2	3
*Miniumum catch rate required: 22.7					34 poor

Site 4
Drainage area: 1.5 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<3	3 - 4	>4	7	5
Number of riffle species	<1	1	>1	1	3
Number of pool species	<1		>0	3	5
Percent individuals of two dominant species	>88	77 - 88	<77	89.4	1
Number of headwater intolerant species	<1	1	>1	0	1
Percentage of tolerant species	>40	20 - 40	<20	2	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	27.4	3
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<7	7 - 13	>13	3.4	1
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<44.9	44.9 - 89.6	>89.6	89.7	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	65.4	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 22.5					40 fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 5 Drainage area: 28.62 sq.mi Ecoregion: Ridge and Valley					
Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<11	11 - 21	>21	22	5
Number of darter species	<3	3 - 4	>4	5	5
Number of sunfish species, excluding *Micropterus* species	<2	2	>2	1	1
Number of sucker species	<2	2	>2	2	3
Number of intolerant species	<2	2 - 3	>3	5	5
Percentage of tolerant species	>32	17 - 32	<17	1	5
Percentage of omnivores and stoneroller species	>38	20 - 38	<20	27.3	3
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<20	20 - 39	>39	67.2	5
Percentage of individuals as piscivores*	<2	2 - 4	>4	1.2	1
Catch rate (number of fish per 300 sq. ft.)	<20.2	20 - 40.3	>40.3	40.4	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 10.1					48 good

Site 6 Drainage area: 3.82 sq.mi Ecoregion: Ridge and Valley					
Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<5	5 - 9	>9	15	5
Number of riffle species	<2	2	>2	3	5
Number of pool species	<4	4 - 7	>7	9	5
Percent individuals of two dominant species	>84	69 - 84	<69	67.7	5
Number of headwater intolerant species	<2	2 - 3	>3	4	5
Percentage of tolerant species	>40	20 - 40	<20	3	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	62.5	1
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<11	11 - 21	>21	21.7	5
Percentage of individuals as piscivores*	<1.5	-2.9	>2.9	0.1	1
Catch rate (number of fish per 300 sq. ft.)	<34.9	34.9 - 69.6	>69.6	69.7	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	33.7	3
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 17.5					50 good

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 7
Drainage area: 3.07 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<5	5 - 8	>8	8	3
Number of riffle species	<2	2	>2	1	1
Number of pool species	<4	4 - 6	>6	5	3
Percent individuals of two dominant species	>85	71 - 85	<71	63.2	5
Number of headwater intolerant species	<2	2	>2	1	1
Percentage of tolerant species	>40	20 - 40	<20	3	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	17.1	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<10	10 - 19	>19	19.2	5
Percentage of individuals as piscivores*	<1.4	1.4 - 2.6	>2.6	0.4	1
Catch rate (number of fish per 300 sq. ft.)	<37	37 - 73.8	>73.8	37	3
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	64.1	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 18.5					42 fair

Site 8
Drainage area: 16.10 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<10	10 - 18	>18	19	5
Number of darter species	<2	2 - 3	>3	5	5
Number of sunfish species, excluding *Micropterus* species	<2	2	>2	1	1
Number of sucker species	<2	2	>2	1	1
Number of intolerant species	<2	2 - 3	>3	4	5
Percentage of tolerant species	>34	18 - 34	<18	2	5
Percentage of omnivores and stoneroller species	>41	21 - 41	<21	18.9	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<18	18 - 34	>34	68.6	5
Percentage of individuals as piscivores*	<2	2 - 4	>4	2.7	3
Catch rate (number of fish per 300 sq. ft.)	<23.6	23.6 - 47.1	>47.1	47.2	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 11.8					50 good

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 9 Drainage area: 1.89 sq.mi Ecoregion: Ridge and Valley					
Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<3	3 - 5	>5	6	5
Number of riffle species	<1	1	>1	1	3
Number of pool species	<1		>0	4	5
Percent individuals of two dominant species	>87	75 - 87	<75	85.5	3
Number of headwater intolerant species	<1	1	>1	1	3
Percentage of tolerant species	>40	20 - 40	<20	2	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	22.2	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<8	8 - 15	>15	10.1	3
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<42.1	42.1 - 84.1	>84.1	84.2	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	57	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 21.1					48 good

Site 10 Drainage area: 4.49 sq.mi Ecoregion: Ridge and Valley					
Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<6	6 - 10	>10	6	5
Number of riffle species	<2	2 - 3	>3	1	3
Number of pool species	<5	5 - 8	>8	4	5
Percent individuals of two dominant species	>83	68 - 83	<68	74.4	3
Number of headwater intolerant species	<2	2 - 3	>3	0	1
Percentage of tolerant species	>40	20 - 40	<20	2	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	4	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<12	12 -23	>23	21.6	3
Percentage of individuals as piscivores*	<1.6	1.6	>3.1	0	1
Catch rate (number of fish per 300 sq. ft.)	<33.4	33.4 - 66.6	>66.6	33.4	3
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	75.6	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 16.7					44 fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 11
Drainage area: 10.99 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<8	8 - 15	>15	17	5
Number of darter species	<2	2 - 3	>3	3	3
Number of sunfish species, excluding *Micropterus* species	<2	2	>2	1	1
Number of sucker species	<2	2	>2	2	3
Number of intolerant species	<2	2	>2	4	5
Percentage of tolerant species	>36	19 - 36	<19	3	5
Percentage of omnivores and stoneroller species	>44	23 - 44	<23	33.6	3
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<16	16 - 30	>30	17.5	3
Percentage of individuals as piscivores*	<2	2 - 4	>4	2	3
Catch rate (number of fish per 300 sq. ft.)	<26.2	26.2 - 52.3	>52.3	52.4	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	<2	<2	1	5
*Miniumum catch rate required: 13.1					46 fair/good

Site 12
Drainage area: 2.74 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<4	4 - 7	>7	5	3
Number of riffle species	<2	2	>2	1	1
Number of pool species	<4	4 - 6	>6	2	1
Percent individuals of two dominant species	>85	72-85	<72	82.5	3
Number of headwater intolerant species	<2	2	>2	0	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	1.1	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<10	10 - 18	>18	16.9	3
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<38.1	38.1 - 76.1	>76.2	76.2	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	79.8	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	2	1	5
*Miniumum catch rate required: 19.1					38 poor/fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 13
Drainage area: 6.57 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<7	7 - 12	>12	7	3
Number of darter species	<2	2	>2	2	3
Number of sunfish species, excluding *Micropterus* species	<1	1	>1	0	1
Number of sucker species	<1	1	>1	1	3
Number of intolerant species	<2	2	>2	2	3
Percentage of tolerant species	>38	20 - 38	<20	2	5
Percentage of omnivores and stoneroller species	>48	25 - 48	<25	13.4	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<14	14 - 26	>26	15.1	3
Percentage of individuals as piscivores*	1.8	1.8 - 3.5	>3.5	0	1
Catch rate (number of fish per 300 sq. ft.)	<30.1	30.1 - 60.1	>60.1	60.2	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 15.1					42 fair

Site 14
Drainage area: 3.43 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<5	5 - 9	>9	6	3
Number of riffle species	<2	2	>2	1	1
Number of pool species	<4	4 - 7	>7	4	3
Percent individuals of two dominant species	>84	70 - 84	<70	60.6	5
Number of headwater intolerant species	<2	2	>2	1	1
Percentage of tolerant species	>40	20 - 40	<20	2	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	7.3	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<11	11 - 20	>20	28.4	5
Percentage of individuals as piscivores*	<1.5	1.5 - 2.8	>2.8	0	1
Catch rate (number of fish per 300 sq. ft.)	<35.9	35.9 - 71.6	>71.6	71.7	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	55	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	2	1	5
*Miniumum catch rate required: 18					44 fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 15
Drainage area: 2.33 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<4	4-6	>6	5	3
Number of riffle species	<2	2	>2	1	1
Number of pool species	<3	3 - 5	>5	2	3
Percent individuals of two dominant species	>86	73 - 86	<73	72.7	5
Number of headwater intolerant species	<2	2	>2	1	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	1.3	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<9	9 - 17	>17	5.2	1
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<39.8	39.8 - 79.5	>79.5	39.8	3
Percentage of individuals as lithophilic spawners	<25	25 - 5-	>50	68.8	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 19.9					38 poor/fair

Site 16
Drainage area: 9.97 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<8	8 - 15	>15	17	5
Number of darter species	<2	2 - 3	>3	3	3
Number of sunfish species, excluding *Micropterus* species	<1	1	>1	1	3
Number of sucker species	<2	2	>2	2	3
Number of intolerant species	<2	2	>2	4	5
Percentage of tolerant species	>36	19 - 36	<19	3	5
Percentage of omnivores and stoneroller species	>45	23 -45	<23	39.1	3
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<15	15 - 29	>29	30.3	5
Percentage of individuals as piscivores*	<2	2 - 3.9	>3.9	6.7	5
Catch rate (number of fish per 300 sq. ft.)	<26.9	26.9 - 53.7	>53.7	53.8	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 13.5					52 good

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 17
Drainage area: 0.87 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<1		>0	2	5
Number of riffle species	<1		>0	0	1
Number of pool species	<1		>0	1	3
Percent individuals of two dominant species	>90	80 - 90	<80	100	1
Number of headwater intolerant species	<1		>0	0	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	0	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<1		>0	0	1
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<52	52 - 103.8	>103.8	103.9	5
Percentage of individuals as lithophilic spawners	<1		>0	88.8	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 26					38 poor/fair

Site 18
Drainage area: 19.42 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<10	10 - 19	>19	22	5
Number of darter species	<3	3 - 4	>4	5	5
Number of sunfish species, excluding *Micropterus* species	<2	2	>2	1	3
Number of sucker species	<2	2	>2	2	3
Number of intolerant species	<2	2 - 3	>3	4	5
Percentage of tolerant species	>33	17 - 33	<17	3	5
Percentage of omnivores and stoneroller species	>40	21 - 40	<21	40.7	1
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<18	18 - 35	>35	40	5
Percentage of individuals as piscivores*	<2	2 - 4	>4	1.7	1
Catch rate (number of fish per 300 sq. ft.)	<22.5	22.5 - 44.8	>44.8	44.9	5
Percentage of individuals as hybrids	>1	TR - 1	0	0	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 11.3					48 good

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Site 19
Drainage area: 0.66 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<1		>0	9	5
Number of riffle species	<1		>0	1	5
Number of pool species	<1		>0	6	5
Percent individuals of two dominant species	>90	80 - 90	<80	83.2	3
Number of headwater intolerant species	<1		>0	0	1
Percentage of tolerant species	>40	20 - 40	<20	3	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	9.6	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<1		>0	6.4	5
Percentage of individuals as piscivores*	<1		>0	0.8	1
Catch rate (number of fish per 300 sq. ft.)	>56	56 - 111.8	>111.8	56	3
Percentage of individuals as lithophilic spawners	<1		>0	60.8	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	2	3
*Miniumum catch rate required: 28					46 fair/good

Site 20
Drainage area: 1.18 sq.mi
Ecoregion: Ridge and Valley

Metric Description	Scoring Criteria			# Observed	Score
Number of native fish species	<2	3	>2	4	5
Number of riffle species	<1	2	>0	0	1
Number of pool species	<1		>0	2	5
Percent individuals of two dominant species	>89	79 - 89	<79	84.9	3
Number of headwater intolerant species	<1		>0	0	1
Percentage of tolerant species	>40	20 - 40	<20	1	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	7.5	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<6	6 - 11	>11	7.5	3
Percentage of individuals as piscivores*	<1		>0	0	1
Catch rate (number of fish per 300 sq. ft.)	<47.9	47.9 - 95.6	>95.6	47.9	3
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	83	5
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	2	3
*Miniumum catch rate required: 24					40 fair

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

Fish Index of Biotic Integrity Scoring for selected sites in the Indian Creek watershed, Tazewell, Virginia.

	Site 22				
	Drainage area: 2.1 sq.mi				
	Ecoregion: Ridge and Valley				
Metric Description		Scoring Criteria		# Observed	Score
Number of native fish species	<4	4 - 6	>6	8	5
Number of riffle species	<1	1	>1	1	3
Number of pool species	<3	3 - 5	>5	6	5
Percent individuals of two dominant species	>86	74 - 86	<74	73.3	5
Number of headwater intolerant species	<2	2	>2	1	1
Percentage of tolerant species	>40	20 - 40	<20	3	5
Percentage of omnivores and stoneroller species	>50	25 - 50	<25	9.6	5
Percentage of specialized insectivores* (i.e., darters and certain minnow species)	<9	9 - 16	>16	11.8	3
Percentage of individuals as piscivores*	<1		>0	2.1	5
Catch rate (number of fish per 300 sq. ft.)	<41	41 - 81.8	>81.8	81.9	5
Percentage of individuals as lithophilic spawners	<25	25 - 50	>50	40.1	3
Percentage of individuals with disease, tumors, fin damage or other anomalies	>5	2 - 5	<2	1	5
*Miniumum catch rate required: 20.5					50 good

DIGITAL IMAGES

Phoxinus sp. cf. *saylori*

photo courtesy of Chris Skelton, Georgia College and State University

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 1, mainstem Indian Creek (top); site 2 Lowe Branch (middle); site 3 Lowe Branch (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 4, unnamed tributary (top); site 5 mainstem Indian Creek (middle); site 6 Laurel Fork (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 7, Laurel Fork (top); site 8 mainstem Indian Creek (middle); site 9 Greasy Creek (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 10 Greasy Creek (top); site 11 mainstem Indian Creek (middle); site 12 Jackson Fork (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 13 mainstem Indian Creek (top); site 14 North Branch (middle); site 15 South Branch (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 16 mainstem Indian Creek (top); site 17 Panther Branch (middle); site 18 mainstem Indian Creek (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 19 Coal Branch (top); site 20 Raven Nest Branch (middle); site 21 mainstem Indian Creek (bottom).

Indian Creek watershed, Tazewell County, Virginia, sampling locations: site 22 uppermost reach of North Branch.