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Intensive Water Quality and Biological Study of Choccolocco and Snow Creeks, Coosa River Basin

Submitted to:

Monsanto Company

by

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EXHIBIT

3

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

EXECUTIVE SUMMARY

Biotic and abiotic factors potentially affecting stream quality were studied in Snow and Choccolocco Creeks in northeastern Alabama. The objective of the study was to determine the ecological health of Snow and Choccolocco Creeks from assessments of physical, chemical and biological variables typically used to characterize stream quality. Many human activities on these watersheds affect the water quality and ecological integrity of both streams. For example, Snow Creek is an urban stream that has received heavy impacts from both point-source and nonpoint-source pollution for many years. Study sites on Snow Creek were selected at locations from the headwaters to the mouth of Snow Creek, and study sites on Choccolocco Creek were selected from the headwaters of the creek to Lake Logan Martin. In addition, undisturbed reference streams from the same ecoregion were selected for comparison to Snow and Choccolocco Creeks. In October and November of 1996, variables from sites in Snow and Choccolocco Creeks were compared with those from similar-sized reference streams for an assessment of ecological health.

The study of physical habitat included estimates of substrate type, available cover, embeddedness of substrate, channel alterations, scouring and deposition, and riparian and bank stability. Water quality analyses included temperature and dissolved oxygen (DO), pH, turbidity, conductivity, total suspended solids, total organic carbon, alkalinity and nutrients (nitrogen and phosphorus). The biotic variables included measures of the diversity of benthic macroinvertebrate communities. Macroinvertebrates are aquatic insect larvae and other organisms (for example, worms, snails, mussels) that live among the bottom (benthic) substrates.

The results of this study indicate that the physical conditions in Snow Creek and sections of Choccolocco Creek have been greatly altered when compared to the reference streams. Clearing of riparian vegetation and channelization has eliminated many of the meanders typical in undisturbed streams. Consequently, water temperatures were higher in both streams compared to the reference sites. Also, sedimentation has altered the amount of stable habitat available for macroinvertebrates. While the reference streams contain predominantly gravel, cobble and boulder, Snow and Choccolocco Creeks are comprised of mostly sand and gravel. Even at sites where cobble and boulder were present, habitat available for colonization was reduced because of greater sedimentation. Choccolocco Creek between Alabama Highway 9 and Interstate 20 had large quantities of woody debris. The logs and limbs provided stable habitat for macroinvertebrates; thus, communities in this section were more diverse than those found at stations just below confluence of Snow and Choccolocco Creeks.

Chemical analyses confirm that Snow and Choccolocco Creeks received both nonpoint-source and point-source impacts from the watersheds. In Snow Creek, these impacts occurred along the entire channel. For example, storm-water runoff from streets, homes and industries flows into the channel. In addition, a number of permitted discharges are allowed to Snow Creek by industries according to the Alabama Department of Environmental Management (ADEM).

Following heavy rains, nonpoint-source runoff from the watershed strongly affected stream quality in Snow Creek. In particular, heavy rainfall dramatically increased concentrations of suspended solids and the plant nutrients nitrogen and phosphorus over those measured at lower-flow conditions. Following heavy rainfall, water quality in the ditch that drains portions of the watershed which includes the Monsanto plant site and several other commercial and industrial facilities (the

Eleventh Street Ditch) contributed to elevated levels of several variables in Snow Creek at the point of confluence, including nitrites, nitrates, ammonia, total phosphorus, total organic carbon, turbidity and total suspended solids. At lower flows, water quality in the Eleventh Street Ditch had little influence on water quality in Snow Creek.

At higher flows, Snow Creek adversely affected the water quality measured in Choccolocco Creek between confluence of the two streams and the outfall of the Anniston sewage treatment plant. For example, levels of some variables in Choccolocco Creek increased between 5 and 20 times those present above confluence of Snow and Choccolocco Creeks. At lower flows these effects were not nearly as dramatic.

Under lower-flow conditions, when there is little surface runoff, point-source discharges above Snow Creek's confluence with the Eleventh Street Ditch alter the chemistry of Snow Creek. For example, in November, nitrites, nitrates, ammonia, organic nitrogen (TKN), phosphorus and total organic carbon were much higher at the uppermost station on Snow Creek than at downstream sites. The high levels of these variables suggested the presence of organic waste from some unknown source above Snow Creek's confluence with the Eleventh Street Ditch.

In Choccolocco Creek, upstream of its confluence with Snow Creek, there was evidence of nonpoint-source pollution. Total alkalinity, nitrates and conductivity were much higher at these stations than in the reference stream. This was true on both dates, at lower and higher flows. This section of Choccolocco Creek meanders through a valley in which hundreds of acres of sod are produced by a commercial turf farm. Apparently, lime and fertilizers from horticultural or agricultural operations enter the creek with runoff. Data from Choccolocco Creek also demonstrated that the Anniston and Oxford wastewater treatment plants caused increased levels of nitrates, organic nitrogen, phosphorus and conductivity above those measured upstream. These effects were evident only at lower flows.

The study indicated macroinvertebrates were abundant in both Snow and Choccolocco Creeks. The diversity of these communities, however, was dramatically different from that found in the reference streams. Compared to the stations in Snow and Choccolocco Creeks, all of the reference streams were characterized by higher taxa richness. This was particularly true of taxa in the pollution-sensitive EPT groups [i.e., the mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera)]. In contrast, most of the macroinvertebrates from Snow Creek and sections of Choccolocco Creek were organisms that predominate in impacted conditions. For example, in Snow Creek, midges and odonates that are tolerant to pollution predominated.

Nutrient enrichment and sedimentation were obvious "impacts" suggested by the data from this study, although none of the chemicals occurred in concentrations that were acutely toxic to macroinvertebrates. However, stoneflies and many of the caddisflies cannot tolerate stream conditions associated with nutrient enrichment or sedimentation.

PCBs are present at various levels in sediment in Snow and Choccolocco Creeks. However, based on this bioassessment, the ecological health at station 12, just below Snow Creek's confluence with the Eleventh Street Ditch, was as good or better than any other Snow Creek study site. In fact, station 11 just upstream of Snow Creek's confluence with the Eleventh Street Ditch was in the poorest condition (severely impaired) of all sites. There was no evidence that PCBs in sediment were having an adverse impact upon the macroinvertebrate communities of either Snow or Choccolocco Creeks.

INTRODUCTION

This report contains an assessment of biotic and abiotic factors associated with water quality in Choccolocco and Snow Creeks in northeast Alabama. Snow Creek is a small stream flowing through the city of Anniston before discharging into Choccolocco Creek. The watershed for Snow Creek is essentially urban. Choccolocco Creek originates in the northwestern corner of Cleburne County in the mountains of the Talladega National Forest. It flows south to Anniston and then west to the Coosa River (Lake Logan Martin) near the town of Lincoln. Choccolocco Creek is a fourth order stream below its confluence with Shoal Creek near Alabama Highway 9 in northeast Calhoun County to its confluence with Lake Logan Martin.

Polychlorinated biphenyls (PCBs) have been found in the sediments of both creeks. Monsanto Company produced PCBs at its Anniston facility from 1935 to 1971. Many human activities on the watersheds have the potential to affect the water quality and ecological integrity of both streams. For example, extensive dredging, snagging and channelization have occurred in both streams. Portions of the stream bed (bottom and sides) of Snow Creek have been paved. Choccolocco Creek receives nonpoint-source runoff from horticultural, agricultural and forestry operations in the basin. At least four municipal wastewater treatment plants discharge treated effluent to Choccolocco Creek, including Anniston, Oxford, the Anniston Army Depot and the Talledega Airport Industrial Park. The Anniston Army Depot and the Talledega Airport complex are designed to generate about 0.5 million gallons per day (mgd); the Oxford plant is designed for 2 mgd and the Anniston plant is designed for 10.5 mgd. In May 1997, all four plants discharged less than their design capacity. In permits to discharge to Choccolocco Creek (personal communication, Aimee Gray, ADEM). Most of these permits govern the discharge of stormwater runoff.

Rapid bioassessment methods were used to assess biotic factors in the streams. This method relies on benthic macroinvertebrates to assess stream quality (Plafkin et al. 1989). Benthic macroinvertebrates are "bottom-dwelling" aquatic invertebrates that are ubiquitous in streams. Many of these organisms are larval forms of aquatic insects and most are food items for stream fishes. Benthic macroinvertebrates live among, or on, rocks, logs, sediment, leaf packs or vegetation. Life cycles of benthic animals range from a few days to over a year, but most live several months, which allows an examination of seasonal changes caused by perturbations. While some movement is typical among macroinvertebrates, the relatively sedentary nature of these animals allows effective spatial analyses of disturbance effects. As a result, benthic macroinvertebrates act as continuous monitors of the water they inhabit (Rosenberg and Resh 1993). The basic approach in rapid bioassessment includes concurrent sampling of undisturbed sites (reference sites) and sites suspected of having impacts from human activities. Study sites are then compared with the reference sites to assess ecological health.

Several technical developments currently allow biologists to use benthic macroinvertebrates advantageously in biomonitoring programs (Plafkin et al. 1989). First, qualitative sampling and sample analysis use simple, inexpensive equipment (e.g., aquatic dipnets). Second, the taxonomy of many groups common in streams is known, and keys for identification are available. Third, there are many methods of data analysis, including biotic and diversity indices, used in community-level biomonitoring. Fourth, the responses of many common species to different types of conditions are known. And fifth, experimental approaches to biomonitoring easily employ benthic macroinvertebrates.

The objective of this study was to determine the ecological health of Snow and Choccolocco Creeks. Water quality and macroinvertebrates were sampled on two dates in the fall of 1996. Sampling occurred on 9 October and 21 November. Sample stations consisted of undisturbed sites (reference sites) and sites on Snow and Choccolocco Creeks (study sites).

METHODS AND MATERIALS

Study Area

Figure 1 shows the location of each station. Table 1 describes the sampling sites. Study sites on Snow Creek (SN) were on first and second order branches, while all of the study sites on Choccolocco Creek (CH) were on fourth order sections of the creek. Both streams have a use category designation of aquatic fish and wildlife (ADEM 1996). Station 12 was located on Snow Creek just below a ditch that drains portions of the watershed that includes the Monsanto plant site and other commercial and industrial facilities (the Eleventh Street Ditch). Reference sites included segments of South Fork Creek (SF, first order), Choccolocco Creek (second order) and Terrapin Creek (TC, fourth order).

The study area lies in the Central Appalachian Ridges and Valleys (CARV). This ecoregion is characterized by open, low hills and mountains, with a mosaic of cropland, pasture, woodland and forest on mesic inceptisol soils (Omernik 1987). Reference sites were located within the same ecoregion. All reference and study streams were sampled on each date during the survey.

Habitat Assessment

Habitat variables were evaluated according to methods in EPA's rapid bioassessment protocol (Plafkin et al. 1989). Habitats were scored on the basis of instream variables, channel morphology, bank features and streamside (riparian) vegetation (Table 2). Scores for each variable were summed (Table 3) and then compared to the reference stream (Table 4). Substrate composition and canopy cover were also visually estimated for each site.

Water Quality

Water quality variables were measured at twelve locations on Choccolocco and Snow Creeks and three reference streams. Water samples were collected just below the surface (<5 cm) in 2-L Nalgene® bottles on 18 October and 21 November 1996 and transported on ice to an Auburn University laboratory for analysis. Water temperature and dissolved oxygen (DO) were measured in situ at each station. Laboratory analyses of water samples included measurements of pH, total alkalinity (TA), nitrite-nitrogen (NO_2-N), nitrate-nitrogen (NO_3-N), ammonia nitrogen (NH_3-NH_4-N), total Kjeldahl nitrogen (TKN), soluble reactive phosphorus (mostly orthophosphate, PO_4-P), total phosphorus (TP), total organic carbon (TOC), turbidity, conductivity and total suspended solids (TSS).

Temperature, dissolved oxygen and pH are important variables in water quality studies. The pH describes the intensity of acidic or basic characteristics by measuring the effective hydrogen ion concentration (-log[H+]). Alkalinity measures the acid-neutralizing capacity of a solution. Inorganic forms of nitrogen such as nitrites, nitrates and ammonia were measured along with nitrogen from organic sources as total Kjeldahl nitrogen. Nitrates and ammonia are important nutrient sources and nitrogen can limit plant growth in streams. The EPA has established a limit of 10,000 μg/L nitrate in drinking water supplies. Measurements of ammonia range from less than 10 μg/L in natural waters up to 30,000 μg/L in some wastewaters. Unimpacted waters typically have ammonia nitrogen levels below 1,000 μg/L (Lind 1985). Phosphorus is essential to plant growth and can limit aquatic productivity by periphyton and macrophyte communities. Orthophosphate is the most important and abundant form of phosphorus available for plant growth. In some situations, the addition of phosphorus from wastewater sources may lead to nuisance aquatic plant growth. Unimpacted waters usually have less than 10 μg/L orthophosphate (Lind 1985). Total organic carbon is a measurement of all organic compounds in the water. Turbidity is a measurement of the suspended matter in water. Total suspended solids also refers to suspended matter in water, determined by filtration. Clarity of natural waters is a major factor in its overall condition and productivity. Conductivity is the ability of a solution to carry an electric current and is determined by the various anions and cations present in the water. Distilled water has relatively low conductivity at 0.5 to 3 μmhos/cm. Methods for all analyses were conducted according to *Standard Methods* (American Public Health Association 1995) as shown in Table 5.

Macroinvertebrates

Benthic macroinvertebrates were sampled at four stations in Snow Creek and seven stations in Choccolocco Creek (Table 1, Figure 1). Similar sized reference streams were selected from sites in Talladega National Forest and nearby areas within the same ecoregion. Benthic macroinvertebrates were sampled using D-frame aquatic dipnets. At each site all available microhabitats (e.g., rocks, logs, gravel, sand, leaf packs, undercut banks, vegetation) were sampled. The net was placed just downstream of the microhabitat and the substrate disturbed so that the current washed macroinvertebrates into the net. Organisms residing in the sand and those living on large rocks and logs were sampled with a 240 μm mesh net. All other microhabitats were sampled with a 1,000 μm mesh net. Macroinvertebrates were sorted in the field and preserved in 80% ethanol. Sample size usually ranged between 200 and 500 organisms. In the laboratory, macroinvertebrates were identified and counted; then, several metrics (biocriteria) were calculated from each sample (Table 6). The principal metrics calculated from each sample included taxa richness, the Ephemeroptera-Plecoptera-Trichoptera (EPT) Index, and the Hilsenhoff Biotic Index (HBI). The EPT taxa includes those organisms most sensitive to pollution. Data analysis was performed according to modified procedures in EPA's Rapid Bioassessment Protocol III (Plafkin et al. 1989). Once the biocriteria were calculated, the percent comparability between study and reference sites was determined (Table 7).

Metric one was taxa richness. A simple count of the total number of taxa per sample was made. Each study site was then compared to the appropriate reference site and expressed as a percent of the taxa present at the reference site.

Metric two was the modified Hilsenhoff Biotic Index (HBI). Each taxon was assigned a tolerance value based on the organism's tolerance to organic pollutants. Values ranged from zero (intolerant) to 10 (tolerant). Tolerance values were assigned using available data (Hilsenhoff 1987; E.A. Engineering, Service and Technology 1990; Mason 1991). Taxa not listed in the references were assigned a value based on the value for closely related taxa, or of the family level (Hilsenhoff 1988). A few taxa were assigned tolerance values based on other published data and the experience of the research team. The HBI was calculated as a mean of tolerance values weighted by each taxon's abundance. Higher HBI scores mean lower water quality. The reference site HBI score was then compared to each study site and expressed as a percentage.

The third metric was the ratio of the number of scrapers to filtering collectors. Each macroinvertebrate was assigned to a functional feeding group using Merritt and Cummins (1984) and a species list prepared for EPA (E.A. Engineering, Science and Technology 1990). Each study site was then compared to its reference site and expressed as a percent.

The fourth metric was the ratio of EPT individuals to Chironomidae individuals. The numbers of Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) in each sample were distinguished and counted, as were the number of Chironomidae. The Chironomidae are a group of relatively tolerant insects in the order Diptera (Lenat 1993). The study site was compared to the reference site and expressed as a percent.

The percent contribution of the dominant taxon was the fifth metric. The percent contribution of the numerically dominant taxon to the total number of organisms was calculated for each sample and compared directly (not the percentage comparison) to the reference.

The EPT Index was the sixth metric. This was a count of the number of distinct taxa in the Ephemeroptera, Plecoptera, Trichoptera. The study site counts were compared to the reference site and expressed as a percentage.

The seventh metric was the ratio of the number of shredders to the total number of individuals in the sample. The study site was then compared to the reference site and expressed as a percentage. Finally, each calculated metric was given a biological condition score of zero, two, four or six based on its percent comparability to the reference station (Table 6). Scores were totaled and a biological condition assigned based on the site's overall comparison to the reference site (Table 7).

RESULTS

Habitat Assessment

Hydrologic characteristics are provided for the sites where bioassessments were conducted (Table 8). First order streams ranged in width from 1.3 to 1.4 m and discharge was very low at 0.001 to 0.02 m^3/s. Second order streams ranged from 4 to 7.8 m in width and had discharges from 0.04 to 0.28 m^3/s. Fourth order streams had widths of 9.8 to 30.5 m and discharges of 3.39 to 9.12 m^3/s.

Habitat assessment scores for each site are tabulated in Table 9. The physical habitats at the Snow Creek sites were determined not to support an acceptable level of biological health (rated NS, non-supporting) when compared with the reference sites. Choccolocco Creek sites were more variable. Stations 4, 7 and 8 had habitat with the potential to support an acceptable level of biological health. The habitat at sites 2, 3 and 6 showed the potential to partially support an acceptable level of biological health. Station 5 had habitat rated as non-supporting for an acceptable level of biological health.

In comparing habitat in Snow and Choccolocco Creeks with the reference sites, the primary differences were related to the canopy cover, bottom substrate, available microhabitat, degree of embeddedness, and the lack of riffle areas (Table 9). At each site rated non-supporting, stable habitat such as cobble, boulder or woody debris was less than desirable for diverse macroinvertebrate communities. When present, much of the gravel, cobble or boulder was over 75% surrounded by fine sediments, reducing available niches for colonization by macroinvertebrates. Much of the channel in Snow and Choccolocco Creeks has been straightened, creating mostly flat water or shallow riffles. In sections of Choccolocco Creek, woody debris (e.g., logs, limbs, downed trees) continues to provide stable habitat for macroinvertebrates, but not to the same extent as riffle areas.

In Snow Creek, except for station 12, more than 50 % of all riffle areas were characterized by silt, sand and gravel, compared to less than 20% for the references sites (Table 10). Most of the cobble found at station 12 was not naturally occurring rock, but rip rap used to stabilize the stream bottom. Compared to the reference sites, only stations 4, 5, 7 and 8 in Choccolocco Creek had a desirable mixture of the more stable habitat of gravel, cobble and boulder.

Water Quality

October water samples were collected during a rain storm with subsequent elevated water levels due to increased surface runoff. The November samples were collected at low-flow levels with no significant rainfall for several days prior to sampling. The elevated flows in Snow and Choccolocco Creeks during October affected several variables measured during this study. On both dates, the water quality characteristics of Snow Creek influenced water quality in Choccolocco Creek. This influence was most notable at stations 5 and 6.

Water temperature and dissolved oxygen values are shown in Table 11. Compared to the reference sites, temperatures were higher and dissolved oxygen levels lower at most of the study sites. At the high flows in October, the lowest DO measured was 6.9 mg/L in Snow Creek at station 13. At the low flows in November, the lowest DO was 5.8 mg/L in Snow Creek at station 10.

At all sites, pH was near neutrality on both dates (Tables 12 and 13). Values tended to be higher at the study sites in Snow and Choccolocco Creeks when compared to the reference sites. In October, pH in Snow Creek ranged from 6.68 to 7.61 and in November from 7.19 to 7.35. Snow Creek was found to cause only a slight increase in pH in Choccolocco Creek at stations 5 and 6.

Total alkalinity was elevated at all study sites when compared to reference sites (Tables 12 and 13). Alkalinity tended to increase at most downstream stations in Snow and Choccolocco Creeks, particularly during the high flows in October. In Snow Creek, alkalinity ranged from 27 to 72 mg/L on the October date, while during the low-flow conditions in November, values ranged from 89.5 to 151.8 mg/L. The highest reading was at station 12 just below Snow Creek's confluence with the Eleventh Street Ditch. In Choccolocco Creek, total alkalinity ranged from 46.8 mg/L at station 2 in October to 99.8 mg/L at station 9 in November.

Compared to the reference streams, nitrogen concentrations were usually higher in Snow Creek and at stations 5 and 6 in Choccolocco Creek (Tables 12 and 13). Nitrite levels in Snow Creek ranged from 20 to 32 μg/L in October and 9 to 30 μg/L in November compared to 1 μg/L at both reference sites. Nitrite levels peaked in Choccolocco Creek in October at 20 μg/L and 17 μg/L at stations 5 and 6 respectively. In November, nitrites increased to 30 μg/L at station 9. Nitrate levels on both dates were high in Snow Creek, compared to reference sites (Tables 12 and 13). During the high-flow conditions in October, nitrates ranged from a low of 401 μg/L at station 10 to a high of 611 μg/L at station 12. Below the confluence of Snow and Choccolocco Creeks at station 5, nitrates increased to levels at least four times higher than those found at stations 1 through 4. In November, nitrates were again higher in Snow Creek than at reference sites (Table 13). Values ranged from a high of 707 μg/L at station 10 to a low of 245 μg/L at station 12. Also, at station 5 in Choccolocco Creek, nitrates were higher than upstream at stations 1 through 4. In addition, at stations 6 , 8 and 9, nitrates increased 5-fold over values measured at station 5. The nitrate concentration at station 6 was 653 μg/L, and at station 8, the value was 848 μg/L. Station 6 is just downstream of the Anniston wastewater treatment plant (WWTP) and station 8 is downstream of the Oxford WWTP.

The high flows observed in October influenced ammonia-nitrogen at all stations in Snow Creek and at stations 5 and 6 in Choccolocco Creek (Table 12). Ammonia values ranged from 315 μg/L at station 10 to a high of 926 μg/L at station 12. Ammonia concentrations in Choccolocco Creek were influenced by Snow Creek because levels were highest at station 5, then declined a short distance downstream at station 6. At the low flow conditions in November, ammonia levels declined in Snow Creek, except at station 10 where a concentration of 995 μg/L was measured (Table 13). On both dates, ammonia-nitrogen was somewhat higher at station 12 than at station 11.

Organic nitrogen, as TKN, varied from 4 to 15 times higher in Snow Creek than that measured at the reference sites (Tables 12 and 13). Concentrations were much higher in October during the high flows. The highest value measured in Snow Creek was 2,879 μg/L at station 11 in October. The highest TKN measured in Choccolocco Creek was 1,970 μg/L at station 5 in October. Station 5 is just downstream from the mouth of Snow Creek. This value was 10 times higher than that measured upstream in Choccolocco Creek at station 4. Even during the low flows observed in November, organic nitrogen at stations in Snow Creek was higher than either the reference sites or stations in Choccolocco Creek upstream of station 5. In fact, TKN at station 10 in Snow Creek measured 2,693 μg/L, a value 15 times higher than its reference site.

In October, orthophosphate (PO_4-P) and total phosphorus (TP) values were higher in Snow Creek than either the reference sites or most stations in Choccolocco Creek (Tables 12 and 13). In Snow Creek, the PO_4-P ranged from 183 μg/L at station 10 to 59 μg/L at station 13. In Choccolocco Creek, PO_4-P values increased between station 5 and 6 from 98 to 117 μg/L. At station 8, values increased again to 187 μg/L. The Anniston WWTP releases its effluent just downstream from station 5. The Oxford WWTP releases its effluent into Choccolocco Creek between stations

6 and 8. In October, total phosphorus in Snow Creek increased from 351 μg/L at station 10 to a high of 664 μg/L at station 12. In Choccolocco Creek below confluence with Snow Creek, concentrations ranged from 522 μg/L at station 5 down to 118 μg/L at station 9.

In November under low flow conditions, PO_4-P in Snow Creek was less than 40 μg/L at all stations, except for station 10 at which it was 149 μg/L. The PO_4-P in Choccolocco Creek also differed little from the reference sites at stations 1 through 5. Values ranged from 4 to 9 μg/L as PO_4-P. However, at station 6 below the Anniston WWTP, PO_4-P values increased to 82 μg/L; at station 8 below the Oxford WWTP, PO_4-P values increased to 109 μg/L before declining at station 9. Total phosphorus in Snow Creek was considerably lower in November than in October, but values ranged from a high of 240 μg/L at station 10 to a low of 60 μg/L at station 11. These values were still two to three times higher than the reference sites (Table 13). Stations 1 through 5 in Choccolocco Creek differed little from the reference sites, but total phosphorus at stations 6, 8 and 9 was two to three times that measured upstream.

Total organic carbon during October (Tables 12 and 13) was elevated at all Snow Creek stations when compared to the reference sites. In November, only stations 10 and 13 were elevated compared to the reference sites. In Choccolocco Creek, sites 5 and 6 were high in October compared to upstream stations. November sampling in Choccolocco Creek showed no consistent difference in concentration. Highest total organic carbon values in Snow Creek were 17.08 mg/L in October at station 12 below the Eleventh Street Ditch and 14.42 mg/L at station 13 in November.

Turbidity and total suspended solids followed similar trends at stations in Snow and Choccolocco Creeks on both dates (Tables 12 and 13). Both variables were considerably higher in October during the heavy rainfall. For example, in Snow Creek, turbidity ranged from 358 NTU's at station 12 to 87 NTU's at station 10. Total suspended solids showed a similar trend among stations in Snow Creek. Snow Creek also affected measurements of these two variables in Choccolocco Creek. For example, stations 1 through 4 in Choccolocco Creek differed little from the reference sites, but at stations 5 and 6 both turbidity and total suspended solids were much higher than at stations upstream. Downstream from station 6, both variables again declined.

Maximum conductivity in Snow and Choccolocco Creeks was higher at low flows than at high flows (Tables 12 and 13). In Snow Creek, values in November ranged from 182.3 μmhos/cm at station 10 to 298.8 μmhos/cm at station 13. In contrast, during the high flows in October, conductivity ranged from 83.7 μmhos/cm at station 10 to 180.9 μmhos/cm at station 13. The influence of Snow Creek on conductivity in Choccolocco Creek was not as pronounced compared to other variables. At station 5, conductivity did increase slightly compared to upstream sites, but on both dates the greatest increases were at station 6 and 8, downstream from the Anniston and Oxford WWTP's.

Macroinvertebrates

Macroinvertebrates were collected in all streams under low flow conditions. A total of 264 taxa were collected from all streams (Appendix I, Table 1). Of these taxa, 88% were aquatic insects and the remainder consisted mostly of oligochaetes, crayfish, snails and mussels. Insects in the family Chironomidae were the most diverse group of macroinvertebrates comprising 22% of the total taxa. For each date, individual samples along with tolerance values are presented in Appendix I, Tables 2 to 29.

Based on the bioassessment, all stations in Snow Creek were impaired on both dates (Tables 14 and 15). Impairment ranged from moderate to severe. Of the seven biocriteria used in this study, the Hilsenhoff Biotic Index (HBI), the EPT Index, and total taxa richness best illustrated the differences between the reference streams and sites in Snow and Choccolocco Creeks (Table 16 and Figure 2). Compared to the reference streams, the HBI was higher (meaning poorer water quality) at all Snow Creek stations, and the EPT Index and taxa richness were low. For example, the EPT Index from Snow Creek included no taxa in the order Plecoptera (stoneflies) and only one taxon in the order Trichoptera (caddisflies). In contrast, the reference streams had many taxa in both the orders Plecoptera and Trichoptera. In Choccolocco Creek, stations 2, 3 and 4 differed little compared to the reference stream in October. All three of these stations were non-impaired. In November, these same three stations were slightly impaired because of reduced total and EPT taxa richness (except at station 4). At stations 5, 6, 7 and 8, impairment ranged from slight to moderate on both dates. Compared to the reference stream, HBI values were high and taxa richness and the EPT index were low at stations 5, 6, 7 and 8.

DISCUSSION

Based on the habitat assessment, physical conditions in all of Snow Creek and several sections of Choccolocco Creek have been greatly altered. Compared to the undisturbed "reference" streams of similar size, Snow and Choccolocco Creeks have been subjected to extensive channelization that has eliminated many of the meanders. In addition, riparian vegetation has been removed along many sections, especially in Snow Creek. This has led to increased water temperatures caused by reduced shading. These changes have also contributed to increased runoff of sediment over the years. Consequently, stable habitat for macroinvertebrates has been changed from gravel, cobble and boulder to mostly sand and gravel (Table 10). Even at sites where cobble and boulder were present, many of the microhabitats available for colonization by macroinvertebrates had been eliminated by sedimentation. Cracks and crevices among rocks and submersed wood serve as ideal microhabitat for macroinvertebrates (Merritt and Cummins 1996). Portions of Choccolocco Creek below the confluence with Shoal Creek had large quantities of woody debris that had not been removed by "snagging". The logs and limbs provided stable habitat for macroinvertebrates; thus, communities in this section of the stream (stations 2 and 3) were more diverse (Table 16) than those found at stations 5 and 6 where woody debris was scarce.

Chemical analyses demonstrated that Snow and Choccolocco Creeks are impacted by both nonpoint-sources and point-sources from the watersheds. In Snow Creek, these impacts occurred along the entire channel because the watershed lies within the cities of Anniston and Oxford. Much of the storm-water runoff from streets, homes and industries near the creek flows into the channel. In addition, a number of permitted discharges by industries are allowed to both streams by ADEM.

The fact that water samples were collected on two dates, one during a heavy rain storm (October) and one following several days of dry weather (November), proved helpful in interpreting water quality impacts in Snow and Choccolocco Creeks. For example, if point-source discharges determine the "typical" water chemistry in Snow Creek, then the rain storm should have diluted these variables. Instead, for most variables measured in Snow Creek, concentrations were higher during high-flow conditions (often by an order of magnitude) than those measured at the reference sites (Table 12). These results indicated that nonpoint-source runoff from the watershed strongly affected stream quality in Snow Creek. Compared to lower-flow conditions, the rain event dramatically increased concentrations of suspended solids and the plant nutrients nitrogen and phosphorus. Also, water quality in the Eleventh Street Ditch at high-flow conditions caused elevated levels of several variables compared to those measured upstream or downstream. This was true for nitrites, nitrates, ammonia, total phosphorus, total organic carbon, turbidity and total suspended solids (Table 12). However, at lower flows, water quality in the Eleventh Street Ditch had little influence on water quality in Snow Creek (Table 13).

The concentrations of chemicals and suspended sediment in Snow Creek affected Choccolocco Creek at station 5 just below the confluence of the two streams. At higher flows, Snow Creek increased the levels of some variables in Choccolocco Creek between 5 and 20 times the concentrations present above the confluence of the streams (Table 12). However, the impacts were less noticeable at lower flows (Table 13).

The data collected during lower flows when there was little surface runoff suggested that point-source discharges above station 10 altered the chemistry of Snow Creek (Table 13). For example, in November, nitrites, nitrates, ammonia, organic nitrogen (TKN), phosphorus and total organic carbon were all much higher at station 10 than at stations 11, 12 or 13. The high levels of these variables suggested the presence of organic waste from some unknown source above the confluence of Snow Creek and the Eleventh Street Ditch. Because discharge was so low at station 10 (Table 8), it would not require large quantities of waste to produce the concentrations measured in this study.

Upstream of the confluence of Snow and Choccolocco Creeks, there was evidence of nonpoint-source pollution at stations 1 through 4 on Choccolocco Creek (Tables 12 and 13). Total alkalinity, nitrates and conductivity were much higher at these sites than in the reference stream. This was true at low and high flows. This section of Choccolocco Creek meanders through a valley in which hundreds of acres of sod are produced by a commercial turf farm. Apparently, lime and fertilizers from horticultural and agricultural operations enter the creek with runoff.

Data collected in November at stations 6 and 8 in Choccolocco Creek demonstrated that the Anniston and Oxford WWTPs caused increased levels of nitrates, organic nitrogen, phosphorus and conductivity when compared to those measured upstream. However, these effects were evident only at low flows (Table 13).

Macroinvertebrates were abundant at all stations in both Snow and Choccolocco Creeks. The diversity of these communities was dramatically different, however, from that found in the reference streams. Compared to stations in Snow and Choccolocco Creeks, all of the reference streams were characterized by higher taxa richness. This included a diverse group of taxa in the pollution-sensitive EPT groups. In contrast, many of the macroinvertebrates collected from Snow Creek and sections of Choccolocco Creek have been identified as organisms that occur primarily in impacted streams (Hilsenhoff 1988). For example, in Snow Creek predominantly midges (family Chironomidae) and odonates that are tolerant to impacted stream conditions were found. However, a small number of mayflies was collected at station 12 that were not found at the other Snow Creek sites. The greater quantity of cobble (rip rap) at this site may account for the presence of these mayflies.

Nutrient enrichment and sedimentation were obvious "impacts" suggested by the water quality data in this study, although none of the chemical variables occurred in concentrations that were acutely toxic to macroinvertebrates. However, macroinvertebrates such as the Plecoptera (stoneflies) and many of the Trichoptera (caddisflies) cannot tolerate highly enriched conditions (Lenat 1993).

Based upon this assessment, it is concluded that the biological condition at station 12, just downstream from the confluence of the Eleventh Street Ditch and Snow Creek, was as good or better than that at any other Snow Creek study site (Tables 14 and 15). Station 11 upstream of the confluence of Snow Creek and the Eleventh Street Ditch was in the poorest condition (severely impaired). There was no evidence that the presence of PCBs in sediment of Snow or Choccolocco Creeks adversely affected macroinvertebrate communities in either stream.

CONCLUSIONS

Results of this study revealed the following: 1) Snow Creek has been physically, chemically and biologically altered and impaired by human activities on the watershed; 2) The ecological condition of the benthic community just downstream from the confluence of the Eleventh Street Ditch and Snow Creek was as good or better than that at any other Snow Creek Study site; 3) The discharge of Snow Creek into Choccolocco Creek had an adverse influence on water quality of Choccolocco Creek, particularly during the October sample when rainfall and runoff increased stream discharge; 4) The presence of the Anniston and Oxford WWTP outfalls downstream from the mouth of Snow Creek made it impossible to determine how far downstream Snow Creek impacted water quality of Choccolocco Creek; 5) Agricultural and horticultural impacts which were measured on water quality of Choccolocco Creek upstream of confluence with Snow Creek, and the Anniston and Oxford WWTPs adversely affected water quality of Choccolocco Creek downstream from the confluence with Snow Creek; 6) There was no evidence from this study that the presence of PCBs in sediment of Snow or Choccolocco Creeks adversely affected macroinvertebrate communities in either stream.

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FIGURES AND TABLES

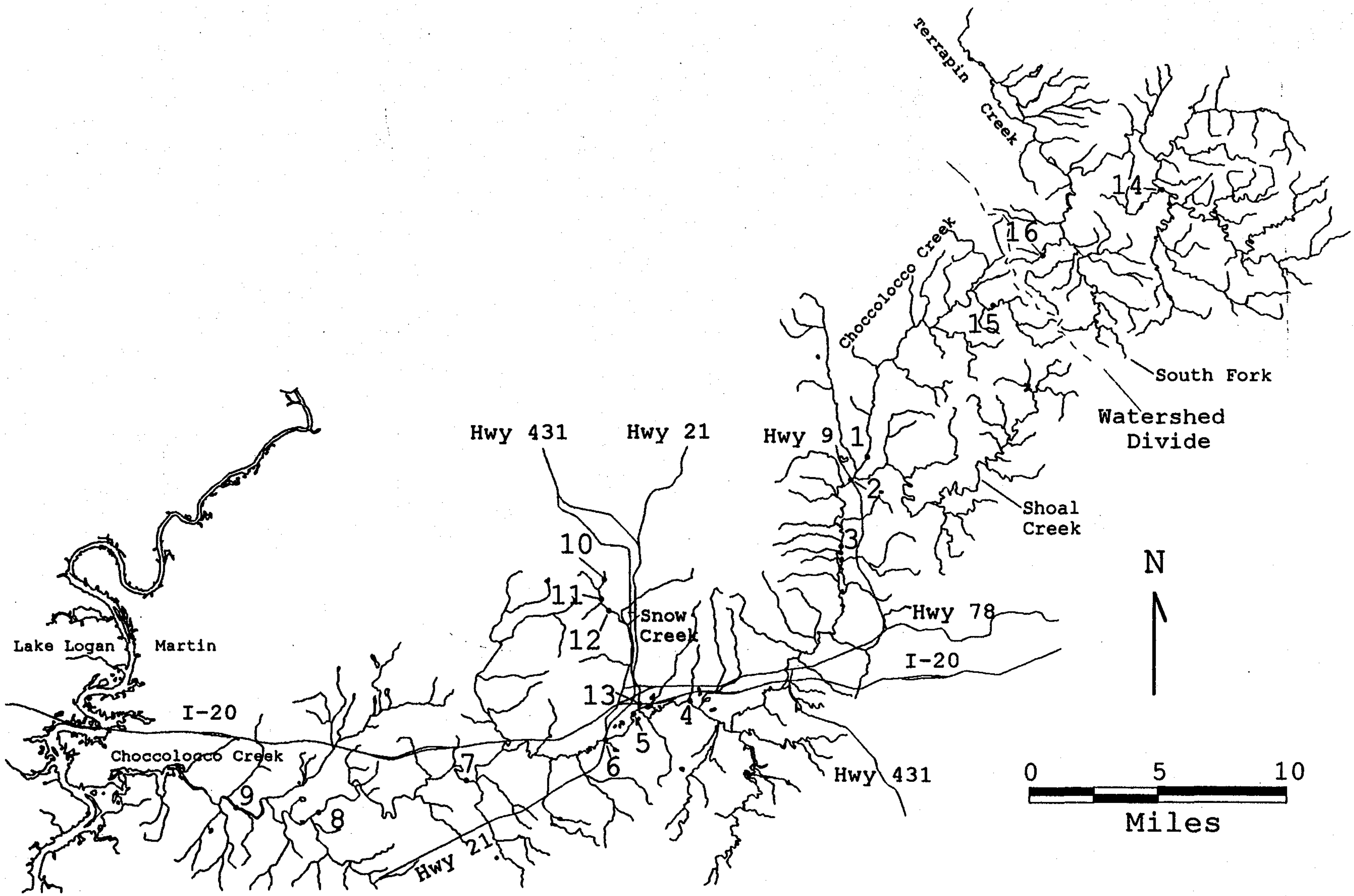

Figure 1. Sampling stations on Choccolocco and Snow creeks and their reference sites, 1996-1997.

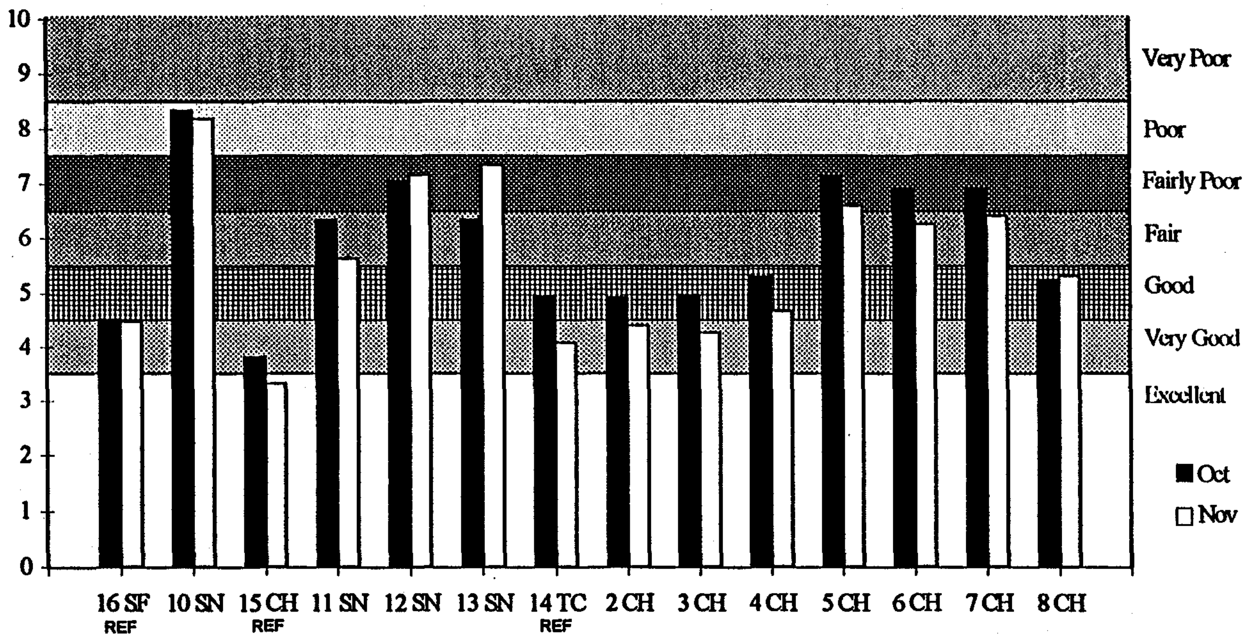

Figure 2. Hilsenhoff Biotic Index scores for Choccolocco and Snow Creeks and reference sites, 1996-1997.

Sites: SF = South Fork of Terrapin Creek, SN = Snow Creek, TC = Terrapin Creek, CH = Choccolocco Creek.

Table 1. Sampling stations, description and type of data collected in Choccolocco and Snow Creeks and their reference sites, 1996-1997.

Sampling Stations	Description	Data Collected[2]
First Order		
South Fork of Terrapin Creek		
16 (REF[1])	Forest Service Rd 500, off Cleburne Co. 55	wq, m
Snow Creek		
10	Just downstream from Alexandria Rd crossing	wq, m
Second Order		
Choccolocco Creek		
15 (REF)	Forest Service Rd 540, off Cleburne Co. 55	wq, m
Snow Creek		
11	15th St. and Boynton Ave., downstream of Union Foundry, upstream of confluence with the Eleventh Street Ditch	wq, m
12	11th St. just downstream of confluence with the Eleventh Street Ditch	wq, m
13	Just upstream of confluence with Choccolocco Ck.	wq, m
Fourth Order		
Terrapin Creek		
14 (REF)	Just upstream of Cleburne Co. 49 crossing	wq, m
Choccolocco Creek		
1	N.E. of AL Hwy 9 near Whitesides Mill	wq
2	AL Hwy 9 bridge crossing	wq, m
3	E. of AL Hwy 9, Joseph Springs Road	wq, m
4	S. of Boiling Springs Exit off I-20	wq, m
5	Upstream Anniston sewage treatment plant, downstream of Snow Ck.	wq, m
6	Just below bridge on Friendship Rd.	wq, m
7	Bridge crossing, N. of Mumford, AL, Hwy 109	m
8	Bridge crossing on Talledega Co. Rd. 005	wq, m
9	Bridge crossing on Talledega Co. Rd. 326	wq

[1]REF = Reference sites.
[2]wq = water quality, m = macroinvertebrates

Table 2. Habitat Assessment Field Data Sheet.

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat parameter	Category			
	Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 20-16	30-50% rubble, gravel or other stable habitat. Adequate habitat. 15-11	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 10-6	Less than 10% rubble, gravel or other stable habitat. Lack of habitat is obvious. 5-0
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25% surrounded by fine sediment. 20-16	Gravel, cobble, and boulder particles are between 25 and 50% surrounded by fine sediment. 15-11	Gravel, cobble, and boulder particles are between 50 and 75% surrounded by fine sediment. 10-6	Gravel, cobble, and boulder particles are over 75% surrounded by fine sediment. 5-0
3. ≤0.15 cms (5 cfs) -> *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 20-16	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 15-11	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 10-6	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 5-0
or >0.15 cms (5 cfs) -> Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 20-16	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 15-11	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 10-6	Dominated by one velocity/depth category (usually pool). 5-0
4. *Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 15-12	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 11-8	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 7-4	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 3-0
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 15-12	5-30% affected. Scour at constriction and where grades steepen. Some deposition in pools. 11-8	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 7-4	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 3-0

Table 2 (cont.)

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 15-12	7-15. Adequate depth in pools and riffles. Bends provide habitat. 11-8	15-25. Occasional riffle or bend. Bottom contours provide some habitat. 7-4	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 3-0
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 10-9	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 8-6	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 5-3	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 2-0
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 10-9	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 8-6	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 5-3	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 2-0
9. Streamside cover[b]	Dominant vegetation is shrub. 10-9	Dominant vegetation is of tree form. 8-6	Dominant vegetation is grass or forbes. 5-3	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 2-0

Column Totals ______ ______ ______ ______

SCORE______

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS.

Table 3. Habitat assessment scoring criteria used to evaluate water quality in Choccolocco and Snow Creeks and reference sites, 1996-1997.

Condition/Parameter	Range of Condition			
	Excellent	Good	Fair	Poor
PRIMARY - SUBSTRATE AND INSTREAM COVER				
1. Bottom substrate and available cover	20-16	15-11	10-6	5-0
2. Embeddedness	20-16	15-11	10-6	5-0
3. Flow/Velocity	20-16	15-11	10-6	5-0
SECONDARY - CHANNEL MORPHOLOGY				
4. Channel alteration	15-12	11-8	7-4	3-0
5. Bottom scouring and deposition	15-12	11-8	7-4	3-0
6. Pool/riffle, run/bend ratio	15-12	11-8	7-4	3-0
TERTIARY - RIPARIAN AND BANK STRUCTURE				
7. Bank stability	10-9	8-6	5-3	2-0
8. Bank vegetation	10-9	8-6	5-3	2-0
9. Streamside cover	10-9	8-6	5-3	2-0

Table 4. Habitat assessment used to evaluate water quality in Choccolocco and Snow Creeks and reference sites, 1996-1997.

Assessment Category	Percent of Comparability
Comparable to Reference	≥90%
Supporting[1]	75-88%
Partially Supporting	60-73%
Non-Supporting	≤58%

[1]Potential to support an acceptable level of biological health.

Table 5. Analytical methods used in measuring water quality in Choccolocco and Snow Creeks and reference sites, 1996-1997.

Variable	Method	Reference
<u>In Situ</u>		
Temperature	thermistor	APHA[1], 1995
Dissolved oxygen	membrane electrode	APHA, 1995
Laboratory Analyses		
pH	glass electrode	APHA, 1995
Alkalinity	potentiometric titration	APHA, 1995
Nitrite (NO_2-N)	diazotizing method	APHA, 1995
Nitrate (NO_3-N)	cadmium reduction	APHA, 1995
Total ammonia (NH_3-NH_4-N)	phenate method	APHA, 1995
Total Kjeldahl nitrogen	macro Kjeldahl	APHA, 1995
Soluble reactive phosphorus	ascorbic acid	APHA, 1995
Total phosphorus	persulfate digestion, ascorbic acid	APHA, 1995
Total organic carbon	persulfate digestion, with Dohrmann DC-80	APHA, 1995
Turbidity	HACH turbidimeter	APHA, 1995
Specific conductance	conductivity cell	APHA, 1995
Total suspended solids	vacuum filtration	APHA, 1995

[1](American Public Health Association 1995)

Table 6. Metrics and biological scores for evaluating water quality in Choccolocco and Snow Creeks and references sites, 1996-1997.

Metric	Biological Scores 6	4	2	0
1. Taxa Richness[1]	>80%	60-80%	40-60%	<40%
2. Hilsenhoff Biotic Index (modified)[2]	>85%	70-85%	50-70%	<50%
3. Ratio of Scrapers/Filt. Collectors[1,3]	>50%	35-50%	20-35%	<20%
4. Ratio of EPT/Chirn Abundances[1]	>75%	50-75%	25-50%	<25%
5. % Contribution of Dominant Taxon[4]	<20%	20-30%	30-40%	>40%
6. EPT Index[1]	>90%	80-90%	70-80%	<70%
7. Ratio of Shredders/Total[1,3]	>50%	35-50%	20-35%	<20%

[1]Score is based on the ratio of metric values for the study site to reference site X 100.
[2]Score is based on the ratio of reference site to study site X 100.
[3]Determination of Functional Feeding Group is independent of taxonomic grouping.
[4]Scoring criteria evaluate actual percent contribution, not percent comparability to the reference station.

Table 7. Bioassessment criteria used to evaluate water quality in Choccolocco and Snow Creeks and references sites, 1996-1997.

% Comparability to Reference Score[1]	Biological Condition Category	Attributes
>83%	Nonimpaired	Comparable to the best situation to be expected within an ecoregion. Balanced trophic structure. Optimum community structure (composition and dominance) for stream size and habitat quality.
54-79%	Slightly impaired	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of some intolerant forms increases.
21-50%	Moderately impaired	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
<17%	Severely impaired	Few species present. If high densities of organisms, then dominated by one or two taxa.

[1]Percentage values intermediate to the above ranges requires subjective judgement as to the correct placement. Habitat assessment and physicochemical data are used to make the final placement.

Table 8. Hydrological measurements and stream order for each station in Choccolocco and Snow Creeks and reference streams, 1996-1997.

Site	Stream Order	Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Discharge[1] (m^3/s)
First Order					
South Fork of Terrapin Creek					
16 (REF[2])	1	1.4	0.12	0.12	0.02
Snow Creek					
10	1	1.3	0.11	0.01	0.001
Second Order					
Choccolocco Creek					
15 (REF)	2	7.3	0.18	0.22	0.28
Snow Creek					
11	2	4.6	0.23	0.04	0.04
12	2	4.0	0.13	0.07	0.04
13	2	7.8	0.13	0.15	0.17
Fourth Order					
Terrapin Creek					
14 (REF)	4	16.1	0.23	0.34	1.36
Choccolocco Creek					
2	4	17.3	0.45	0.43	3.39
3	4	17.7	0.74	0.25	3.49
4	4	27.1	0.76	0.24	5.23
5	4	9.8	0.54	0.59	4.76
6	4	20.8	0.8	0.34	5.7
7	4	30.5	0.35	0.82	9.12
8	4	15.0	0.43	0.65	10.02

[1]Calculated by the sum of intervals.
[2] REF = Reference site.

Table 9. Habitat assessment scores for Choccolocco and Snow Creeks and reference sites, 1996-1997.

	Stream Assessment Score					
	First Order		Second Order			
Streams[1]	SF	SN	CH	SN	SN	SN
Condition/Variable	16	10	15	11	12	13
PRIMARY - SUBSTRATE AND INSTREAM COVER						
1. Bottom substrate & available cover	20	8	20	5	7	10
2. Embeddedness	20	5	20	2	6	10
3. Flow/velocity	20	11	20	11	16	11
SECONDARY - CHANNEL MORPHOLOGY						
4. Channel alteration	15	2	15	3	5	5
5. Bottom scouring and deposition	15	7	15	5	5	5
6. Pool/riffle, run/bend ratio	15	3	15	3	3	7
TERTIARY - RIPARIAN AND BANK STRUCTURE						
7. Bank stability	10	10	10	8	8	7
8. Bank vegetation	10	10	10	9	8	10
9. Streamside cover	10	9	10	5	5	8
Total Score	135	65	135	51	63	73
Percent Comparison	100	48	100	38	47	54
Habitat Assessment	REF	NS	REF	NS	NS	NS

[1]Streams: SF = South Fork of Terrapin Creek, SN = Snow Creek, CH = Choccolocco Creek.
[2]REF=Reference, NS=Non-supporting.

Table 9. Continued.

Condition/Variable	Streams[1]	TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
		Stream Assessment Score Fourth Order							
PRIMARY - SUBSTRATE AND INSTREAM COVER									
1. Bottom substrate & available cover		20	11	15	18	15	10	20	20
2. Embeddedness		20	2	5	18	10	10	20	16
3. Flow/velocity		20	20	20	20	15	20	20	20
SECONDARY - CHANNEL MORPHOLOGY									
4. Channel alteration		15	3	3	15	5	5	7	7
5. Bottom scouring and deposition		15	5	5	10	5	5	11	11
6. Pool/riffle, run/bend ratio		15	11	11	7	7	5	11	11
TERTIARY - RIPARIAN AND BANK STRUCTURE									
7. Bank stability		10	10	10	10	4	10	10	9
8. Bank vegetation		10	9	10	10	6	10	10	9
9. Streamside cover		10	8	9	8	8	8	8	8
Total Score		135	79	88	116	75	83	117	111
Percent Comparison		100	59	65	86	56	61	87	82
Habitat Assessment		REF	NS	PS	S	NS	PS	S	S

[1]Streams: TC = Terrapin Creek, CH = Choccolocco Creek.
[2] REF = Reference, NS = Non-Supporting, PS = Partially Supporting, S = Supporting.

Table 10. Visual estimates of substrate composition (%) and canopy for riffle areas at each station in Choccolocco and Snow Creeks and reference sites, 1996-1997.

		Stream Assessment Score					
		First Order		Second Order			
	Sites[1]	SF	SN	CH	SN	SN	SN
Variable		16	10	15	11	12	13
Substrate							
Silt (< 0.6mm)[2]		1	1	1	3	2	5
Sand (0.6-2mm)		3	49	6	85	25	5
Gravel (2-64mm)		7	49	12	12	20	70
Cobble (64-256mm)		30	1	40	0	50	20
Boulder (>256mm)		59	0	2	0	3	0
Bedrock		0	0	39	0	0	0
		Canopy Description[3]					
Canopy Cover		SH	SH	PS	O	O	SH

[1]Sites: SF=South Fork of Terrapin Creek, SN=Snow Creek, CH=Choccolocco Creek.

[2]Particle Diameter

[3]SH=Shaded, PS=Partially Shaded, PO=Partly Open, O=Open

Table 10. Continued.

Variable	Sites[1]	TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
		Stream Assessment Score Fourth Order							
Substrate									
Silt (< 0.6mm)[2]		1	3	5	5	10	5	1	1
Sand (0.6-2mm)		10	85	85	5	5	20	7	4
Gravel (2-64mm)		30	12	10	15	40	70	12	6
Cobble (64-256mm)		57	0	0	65	45	5	40	74
Boulder (>256mm)		2	0	0	10	0	0	40	15
Bedrock		0	0	0	0	0	0	0	0
		Canopy Description[3]							
Canopy Cover		PS	PO	PO	PO	O	O	PO	PO

[1]Sites: TC=Terrapin Creek, CH=Choccolocco Creek.

[2]Particle Diameter

[3]SH=Shaded, PS=Partially Shaded, PO=Partly Open, O=Open

Table 11. Dissolved oxygen concentration (DO) and temperature measured in Choccolocco and Snow Creeks and reference sites, October and November 1996.

	First Order		Second Order				Fourth Order								
Sites[1]	SF[2] 16	SN 10	CH[2] 15	SN 11	SN 12	SN 13	TC[2] 14	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 8	CH 9
Oct-96															
Temp (°C)	16.5	19.0	16.0	19.5	19.5	19.0	17.0	18.0	18.2	18.2	17.8	19.2	19.0	18.5	18.2
DO (mg/L)	9.5	8.5	9.5	8.5	8.1	6.9	8.8	9.0	8.1	8.1	8.2	7.4	7.6	8.0	9.0
Nov-96															
Temp (°C)	12.2	14.1	12.2	16.5	15.1	15.0	11.8	13.5	14.0	13.9	14.0	14.1	14.1	15.0	15.8
DO (mg/L)	9.4	5.8	10.0	6.4	6.7	6.8	10.2	9.2	9.1	9.2	9.1	8.8	8.8	9.0	9.6

[1]Sites: SF = South Fork of Terrapin Creek, SN = Snow Creek, TC = Terrapin Creek, CH = Choccolocco Creek.
[2] Reference sites.

Table 12. Water quality variables measured in Choccolocco and Snow Creeks and reference sites, October 1996.

		pH	TA[2] (mg/L as $CaCO_3$)	NO_2-N µg/L	NO_3-N µg/L	NH_3-NH_4-N µg/L	TKN µg/L	PO_4-P µg/L	TP µg/L	TOC mg/L	Turbid NTU	Cond µmhos/cm	TSS mg/L
First Order Streams													
[3]SF	16	6.48	18.3	1	16	17	213	16	41	6.60	9.5	58.4	4.07
SN	10	6.68	27.0	27	401	315	1,383	183	351	13.98	87.0	83.7	60.75
Second Order Streams													
CH	15	6.63	19.0	1	15	0	187	18	42	3.31	7.4	47.1	4.91
SN	11	7.56	39.8	27	525	897	2,879	163	567	15.64	254.0	108.2	241.40
SN	12	7.34	47.8	32	611	926	2,731	158	664	17.08	358.0	140.5	314.80
SN	13	7.61	72.0	20	498	304	2,284	59	500	11.58	238.0	180.9	234.47
Fourth Order Streams													
[3]TC	14	6.47	15.3	1	36	3	184	2	26	3.87	9.9	39.8	10.79
CH	1	6.74	51.3	2	117	4	210	8	37	3.68	10.6	116.4	16.81
CH	2	6.65	51.0	1	135	24	290	11	37	4.00	5.9	107.5	7.32
CH	3	6.73	53.8	2	149	37	258	6	41	3.42	8.5	113.4	10.28
CH	4	6.83	62.3	1	101	1	190	7	42	3.26	9.0	127.4	8.85
CH	5	6.88	63.5	20	520	461	1,970	98	522	11.02	238.0	168.9	256.67
CH	6	6.87	64.5	17	486	316	1,366	117	379	8.43	144.0	200.0	162.35
CH	8	7.07	89.3	3	776	19	302	187	230	3.15	9.3	307.3	10.32
CH	9	7.32	99.8	2	606	14	148	84	118	4.58	6.8	266.0	7.74

[1]Streams: SF=South Fork of Terrapin Creek, SN=Snow Creek, TC=Terrapin Creek, CH=Choccolocco Creek.
[2]Variables include pH, total alkalinity (TA), nitrite-nitrogen, (NO_2-N), nitrate-nitrogen (NO_3-N), ammonia nitrogen (NH_3-NH_4-N), Total Kjeldahl Nitrogen (TKN), soluble reactive phosphate (PO_4-P), total phosphorus (TP), total organic carbon (TOC), turbidity (Turbid), conductivity (Conned), and total suspended solids (TSS).
[3]Reference streams.

Table 13. Water quality variables measured in Choccolocco and Snow Creeks and reference sites, November 1996.

		pH	TA (mg/L as $CaCo_3$)	NO_2-N µg/L	NO_3-N µg/L	NH_3-NH_4-N µg/L	TKN µg/L	PO_4-P µg/L	TP µg/L	TOC mg/L	Turbid NTU	Conned µmhos/cm	TSS mg/L
First Order Streams													
[3]SF	16	6.87	19.3	1	14	30	178	3	30	2.24	4.8	48.7	1.33
SN	10	7.19	89.5	30	707	995	2,693	149	240	7.89	6.6	182.3	3.44
Second Order Streams													
CH	15	7.05	23.0	1	0	3	98	12	31	2.26	1.1	45.7	0.01
SN	11	7.35	125.0	10	447	112	276	3	60	2.49	24.0	273.5	16.33
SN	12	7.29	151.8	9	245	154	222	7	62	3.91	12.5	279.3	7.60
SN	13	7.30	135.3	10	361	43	385	40	93	14.42	3.7	298.8	1.81
Fourth Order Streams													
[3]TC	14	7.20	24.0	2	47	24	169	4	31	3.45	8.2	39.1	2.61
CH	1	6.96	51.8	1	96	15	101	5	34	2.46	6.6	117.9	5.23
CH	2	7.03	46.8	1	93	22	86	4	25	2.27	3.4	96.4	2.86
CH	3	7.23	49.0	1	99	3	118	5	40	4.71	4.7	107.2	3.64
CH	4	7.09	55.0	2	91	18	124	7	42	3.15	7.9	119.1	7.07
CH	5	7.30	62.3	1	110	14	151	9	48	3.18	9.9	136.8	10.63
CH	6	7.24	69.0	1	653	31	219	82	125	4.44	10.3	218.8	12.28
CH	8	7.23	85.3	2	848	26	240	109	159	3.53	12.1	243.1	8.84
CH	9	7.29	96.5	30	617	37	166	65	104	2.98	7.8	240.6	4.39

[1]Streams: SF=South Fork of Terrapin Creek, SN=Snow Creek, TC=Terrapin Creek, CH=Choccolocco Creek.
[2]Variables include pH, total alkalinity (TA), nitrite-nitrogen, (NO_2-N), nitrate-nitrogen (NO_3-N), ammonia nitrogen (NH_3-NH_4-N), Total Kjeldahl Nitrogen (TKN), soluble reactive phosphate (PO_4-P), total phosphorus (TP), total organic carbon (TOC), turbidity (Turbid), conductivity (Conned), and total suspended solids (TSS).
[3]Reference streams.

Table 14. Biocriteria (metric) values, percent comparison and biological condition for stations in Choccolocco and Snow creeks and reference sites, October 1996.

	Metric Value						% Comparison				Bioassessment Score					
	First Order		Second Order				First Order	Second Order			First Order		Second Order			
Stream:	SF	SN	CH	SN	SN	SN	SN	SN	SN	SN	SF	SN	CH	SN	SN	SN
Metric / Station:	16	10	15	11	12	13	10	11	12	13	16	10	15	11	12	13
Taxa Richness[1]	44	22	45	16	19	21	50	36	42	47	6	2	6	0	2	2
HBI[2]	4.52	8.33	3.82	6.34	7.04	6.34	54	60	54	60	6	2	6	2	2	2
Scrapers/Filt. Collect[1]	1.46	0.00	3.24	0.00	0.00	0.40	0	0	0	12	6	0	6	0	0	0
EPT/Chiron Abundance[1]	14.17	0.00	6.81	0.00	0.00	0.03	0	0	0	0	6	0	6	0	0	0
% Contrib. of Dom. Taxa[3]	14	36	17	24	21	19	36	24	21	19	6	2	6	4	4	6
EPT Index[1]	15	0	14	0	1	2	0	0	7	14	6	0	6	0	0	0
Shredders/Total[1]	0.15	0.38	0.06	0.01	0.03	0.14	253	17	50	233	6	6	6	0	4	6
Total Score											42	12	42	6	12	16
% Comparison											REF	29	REF	14	29	38
Biological Condition											REF	MOD	REF	SVI	MOD	MOD

[1]Metric values were compared as a ratio of study site to reference site X 100.

[2]Metric values were compared as a ratio of reference site to study site X 100.

[3]Metric values evaluated, not percent comparability.

Sites: SF = South Fork of Terrapin Creek, SN = Snow, CH = Choccolocco

REF = Reference
NON = Non Impaired
SLT= Slightly Impaired
MOD = Moderately Impaired
SVI = Severely Impaired

Table 14. Continued.

Metric	Metric Value, Fourth Order: TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	% Comparison, Fourth Order: CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	Bioassessment Score, Fourth Order: TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
Taxa Richness[1]	41	40	31	37	25	31	31	38	98	76	90	61	76	76	93	6	6	4	6	4	4	4	6
HBI[2]	4.94	4.92	4.96	5.29	7.15	6.92	6.92	5.25	100	100	93	69	71	71	94	6	6	6	6	2	4	4	6
Scrapers/Filt. Collect[1]	0.62	1.08	2.08	2.04	0.52	0.18	1.52	2.58	174	335	329	84	29	245	416	6	6	6	6	6	2	6	6
EPT/Chiron Abundance[1]	6.00	1.97	4.63	3.44	0.43	0.33	0.53	2.20	33	77	57	7	6	9	37	6	2	6	4	0	0	0	2
% Contrib. of Dom. Taxa[3]	14	22	25	19	23	9	13	17	22	25	19	23	9	13	17	6	4	4	6	4	6	6	6
EPT Index[1]	12	10	11	10	7	8	4	9	83	92	83	58	67	33	75	6	4	6	4	0	0	0	2
Shredders/Total[1]	0.02	0.04	0.03	0.09	0.30	0.08	0.15	0.10	200	150	450	1500	400	750	500	6	6	6	6	6	6	6	6
Total Score																42	34	38	38	22	22	26	34
% Comparison																REF	81	90	90	52	52	62	81
Biological Condition																REF	NON	NON	NON	MOD	MOD	SLT	SLT

[1]Metric values compared as a ratio of study site to reference site X 100.

[2]Metric values compared as a ratio of reference site to study site X 100.

[3]Metric values evaluated, not percent comparability.

Sites: TC = Terrapin Creek, CH = Choccolocco

REF = Reference
NON = Non Impaired
SLT = Slightly Impaired
MOD = Moderately Impaired

Table 15. Biocriteria (metric) values, percent comparison and biological condition for stations in Choccolocco and Snow Creeks and reference sites, November 1996.

	Metric Value						% Comparison				Bioassessment Score					
	First Order		Second Order				First Order	Second Order			First Order		Second Order			
Stream:	SF	SN	CH	SN	SN	SN	SN	SN	SN	SN	SF	SN	CH	SN	SN	SN
Metric / Station:	16	10	15	11	12	13	10	11	12	13	16	10	15	11	12	13
Taxa Richness[1]	36	12	45	15	26	16	33	33	58	36	6	0	6	0	2	0
HBI[2]	4.46	8.19	3.33	5.64	7.16	7.34	54	59	47	45	6	2	6	2	0	0
Scrapers/Filt. Collect[1]	0.52	0.00	2.07	0.00	0.00	0.00	0	0	0	0	6	0	6	0	0	0
EPT/Chiron Abundance[1]	7.14	0.00	8.45	0.00	0.09	0.00	0	0	1	0	6	0	6	0	0	0
% Contrib. of Dom. Taxa[3]	16	20	9	24	26	24	20	24	26	24	6	4	6	4	4	4
EPT Index[1]	14	0	19	0	2	0	0	0	11	0	6	0	6	0	0	0
Shredders/Total[1]	0.24	0.23	0.13	0.01	0.05	0.02	96	8	38	15	6	6	6	0	4	0
Total Score											42	12	42	6	10	4
% Comparison											REF	29	REF	14	24	10
Biological Condition											REF	MOD	REF	SVI	MOD	SVI

[1]Metric values compared as a ratio of study site to reference site X 100.

[2]Metric values compared as a ratio of reference site to study site X 100.

[3]Metric values evaluated, not percent comparability.

Streams: SF = South Fork of Terrapin Creek, SN = Snow, CH = Choccolocco

REF = Reference
NON = Non Impaired
SLT = Slightly Impaired
MOD = Moderately Impaired
SVI = Severely Impaired

Table 15. Continued.

Metric Value — Fourth Order

Metric	Stream: Station:	TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
Taxa Richness[1]		49	35	31	61	32	24	41	45
HBI[2]		4.08	4.39	4.27	4.67	6.60	6.26	6.41	5.32
Scrapers/Filt. Collect[1]		0.76	1.30	1.83	0.93	0.89	0.78	0.52	1.55
EPT/Chiron Abundance[1]		34.00	3.39	7.90	6.71	0.53	0.39	1.41	3.76
% Contrib. of Dom. Taxa[3]		13	13	15	15	14	30	13	19
EPT Index[1]		19	13	7	13	9	6	10	7
Shredders/Total[1]		0.19	0.06	0.15	0.07	0.10	0.13	0.05	0.06

% Comparison — Fourth Order

Metric	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
Taxa Richness[1]	71	63	124	65	49	84	92
HBI[2]	93	96	87	62	65	64	77
Scrapers/Filt. Collect[1]	171	241	122	117	103	68	204
EPT/Chiron Abundance[1]	10	23	20	2	1	4	11
% Contrib. of Dom. Taxa[3]	13	15	15	14	30	13	19
EPT Index[1]	68	37	68	47	32	53	37
Shredders/Total[1]	32	79	37	53	68	26	32

Bioassessment Score — Fourth Order

Metric	TC 14	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8
Taxa Richness[1]	6	4	4	6	4	2	6	6
HBI[2]	6	6	6	6	2	2	2	4
Scrapers/Filt. Collect[1]	6	6	6	6	6	6	6	6
EPT/Chiron Abundance[1]	6	0	0	0	0	0	0	0
% Contrib. of Dom. Taxa[3]	6	6	6	6	6	2	6	6
EPT Index[1]	6	0	0	0	0	0	0	0
Shredders/Total[1]	6	2	6	4	6	6	2	2
Total Score	42	24	28	28	24	18	22	24
% Comparison	REF	57	67	67	57	43	52	57
Biological Condition	REF	SLT	SLT	SLT	SLT	MOD	MOD	SLT

[1]Metric values compared as a ratio of study site to reference site X 100.

[2]Metric values compared as a ratio of reference site to study site X 100.

[3]Metric values evaluated, not percent comparability.

Streams: TC = Terrapin Creek, CH = Choccolocco

REF = Reference
NON = Non Impaired
SLT = Slightly Impaired
MOD = Moderately Impaired

Table 16. Comparison of selected biocriteria (metrics) and biological condition for stations in Choccolocco and Snow Creeks and reference sites in October and November 1996.

			First Order		Second Order				Fourth Order							
		Stream:	SF	SN	CH	SN	SN	SN	TC	CH	CH	CH	CH	CH	CH	CH
Metric	Month	Station:	16	10	15	11	12	13	14	2	3	4	5	6	7	8
HBI	OCT		4.52	8.33	3.82	6.34	7.04	6.34	4.92	4.92	4.96	5.29	7.15	6.92	6.92	5.25
	NOV		4.46	8.19	3.33	5.64	7.16	7.34	4.08	4.39	4.27	4.67	6.6	6.26	6.41	5.32
EPT Index	OCT		15	0	14	0	1	2	12	10	11	10	7	8	4	9
	NOV		14	0	19	0	2	0	19	13	7	13	9	6	10	7
Taxa Richness	OCT		44	22	45	16	19	21	41	40	31	37	25	31	31	38
	NOV		36	12	45	15	26	16	49	35	31	61	32	24	41	45
Total Score	OCT		42	12	42	6	12	16	42	34	38	38	22	22	26	34
	NOV		42	12	42	6	10	4	42	24	28	28	24	18	22	24
Biological	OCT		REF	MOD	REF	SVI	MOD	MOD	REF	NON	NON	NON	MOD	MOD	SLT	SLT
Condition[1]	NOV		REF	MOD	REF	SVI	MOD	SVI	REF	SLT	SLT	SLT	SLT	MOD	MOD	SLT
Habitat Assessment[2]			REF	NS	REF	NS	NS	NS	REF	PS	PS	S	NS	PS	S	S

Sites: SF = South Fork of Terrapin Creek, SN = Snow Creek, CH = Choccolocco Creek, TC = Terrapin Creek.

[1]REF=Reference, NON=Non impaired, MOD=Moderately impaired, SLT=Slightly impaired, SVI=Severely impaired.

[2]REF=Reference, NS=Non supporting, PS=Partially supporting, S=Supporting.

APPENDIX

Appendix I

Table 1. Comprehensive taxa list of macroinvertebrates collected in Choccolocco and Snow Creeks and reference sites, 1996.

TAXON	Tolerance[1] Value	FFG[2]
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	CG
Dytiscidae		
Coptotomus spp. adults	5	P
Laccophilus adults	5	P
Uvarus spp. adults	5	P
Elmidae		
Ancyronyx variegatus adults	6	CG
Ancyronyx variegatus larvae	6	CG
Dubiraphia spp. adults	6	CG
Dubiraphia spp. larvae	6	SC
Macronychus glabratus adults	4	CG
Macronychus glabratus larvae	4	SH
Microcylloepus spp. adults	2	CG
Microcylloepus spp. larvae	4	SC
Optioservus spp. adults	4	CG
Optioservus spp. larvae	4	SC
Oulimnius latiusculus adults	4	CG
Stenelmis spp. adults	7	CG
Stenelmis spp. larvae	7	SC
Elmidae larvae	5	CG
Gyrinidae		
Gyrinus spp. adults	4	P
Haliplidae		
Peltodytes spp. adults	5	SH
Peltodytes spp. larvae	5	SH
Hydrochidae		
Hydrochus spp. adults	NA	SH
Hydrophilidae		
Berosus spp. larvae	5	CG
Sperchopsis tessellatus larvae	5	CG
Tropisternus spp. adults	5	CG
Tropisternus spp. larvae	5	P
Hydrophilidae larvae	5	P
Psephenidae		
Ectopria spp. larvae	5	SC
Psephenus herricki larvae	4	SC
Ptilodactylidae		
Anchytarsus bicolor larvae	5	SH
Diptera		
Diptera		
Diptera	NA	NA
Athericidae		
Atherix lantha	2	P
Ceratopogonidae		
Ceratopogonidae	6	P
Chaoboridae		
Chaoboridae	8	P

Table 1. Cont.

TAXON	Tolerance Value	FFG
Chironomidae		
Ablabesmyia spp.	8	P
Cardiocladius spp.	6	P
Chironomus spp.	10	SH
Clinotanypus spp.	8	P
Corynoneura spp.	7	CG
Cricotopus bicinctus	7	CG
Cricotopus tremulus gp.	7	CG
Cricotopus spp.	7	CG
Cricotopus/Orthocladius	7	CG
Cryptochironomus spp.	8	P
Cryptotendipes spp.	6	CG
Dicrotendipes spp.	8	CG
Djalmabatista spp.	3	P
Epoicocladius spp.	4	CG
Eukiefferiella claripennis gp.	8	CG
Goeldichironomus spp.	8	CG
Larsia spp.	6	P
Lopescladius spp.	6	CG
Microtendipes pedellus gp.	6	FC
Microtendipes rydalensis gp.	6	FC
Nanocladius spp.	3	CG
Natarsia spp.	8	P
Nilotanypus spp.	6	P
Nilothauma spp.	2	CG
Orthocladius spp.	6	CG
Pagastiella ostansa	8	NA
Parachaetocladius spp.	6	CG
Paracladopelma spp.	7	NA
Parakiefferiella triquetra	4	CG
Parakiefferiella spp.	6	CG
Paralauterborniella nigrohalteralis	8	CG
Parametriocnemus spp.	5	CG
Paratendipes spp.	8	CG
Phaenopsectra spp.	7	SC
Polypedilum (P.) convictum	7	SH
Polypedilum (P.) fallax	7	SH
Polypedilum (P.) illinoense	6	SH
Polypedilum (I.) halterale	7	SH
Polypedilum (I.) scalaenum gp.	7	SH
Polypedilum spp.	6	SH
Potthastia longimana gp.	4	CG
Procladius spp.	9	P
Psectrocladius spp.	8	CG
Pseudochironomus spp.	5	CG
Rheocricotopus spp.	6	CG
Rheotanytarsus spp.	6	FC
Stenochironomus spp.	5	SH
Stictochironomus divinctus	9	CG
Tanypus spp.	10	P
Tanytarsus spp.	7	FC
Thienemanniella spp.	6	CG
Thienemannimyia complex	6	P
Tribelos spp.	5	CG
Tvetenia bavarica gp.	5	CG
Tvetenia discoloripes gp.	5	CG
Xylotopus par	2	NA
Chironomidae	7	CG
Chironomidae pupae	7	NA
Culicidae		
Anopheles spp.	6	FC
Culex spp.	8	FC
Dixidae		
Dixella spp.	1	CG

Table 1. Cont.

TAXON	Tolerance Value	FFG
Empididae		
Hemerodromia spp.	6	P
Empididae pupae	6	NA
Sciomyzidae		
Dictya spp.	10	P
Sciomyzidae larvae	10	P
Simuliidae		
Simulium spp.	6	FC
Simuliidae pupae	6	NA
Stratiomyidae		
Stratiomys spp.	10	CG
Tabanidae		
Tabanus spp.	7	PI
Tabanus-Whitneyomyia-Atylotus gp.	7	P
Tipulidae		
Antocha spp.	5	CG
Hexatoma spp.	4	P
Tipula spp.	4	SH
Tipulidae	3	SH
Ephemeroptera		
Baetidae		
Acentrella spp.	5	NA
Baetis spp.	6	CG
Heterocloeon spp.	2	SC
Paracloeodes spp.	4	SC
Baetidae	4	CG
Baetiscidae		
Baetisca spp.	5	CG
Ephemerellidae		
Ephemerella spp.	2	SC
Eurylophella spp.	6	SC
Ephemerellidae	1	SC
Ephemeridae		
Ephemera spp.	4	CG
Hexagenia spp.	6	CG
Heptageniidae		
Leucrocuta spp.	4	SC
Stenacron spp.	4	SC
Stenonema exiguum	5	SC
Stenonema mediopunctatum	2	SC
Stenonema modestum gp.	4	SC
Stenonema spp.	5	SC
Heptageniidae	4	SC
Isonychiidae		
Isonychia spp.	3	FC
Leptophlebiidae		
Choroterpes spp.	2	CG
Paraleptophlebia spp.	2	CG
Leptophlebiidae	2	CG

Table 1. Cont.

TAXON	Tolerance Value	FFG
Tricorythidae		
Tricorythodes spp.	5	CG
Hemiptera		
Hemiptera		
Hemiptera	NA	P
Corixidae		
Palmacorixa spp.	NA	P
Trichocorixa spp.	NA	P
Corixidae	NA	PI
Mesoveliidae		
Mesovelia spp.	NA	P
Nepidae		
Ranatra spp.	NA	P
Veliidae		
Microvelia spp.	NA	PI
Steinovelia spp.	NA	P
Lepidoptera		
Pyralidae		
Parapoynx spp.	5	SH
Megaloptera		
Corydalidae		
Corydalus cornutus	6	P
Nigronia fasciatus	2	P
Nigronia serricornis	2	P
Sialidae		
Sialis spp.	4	P
Odonata		
Anisoptera		
Anisoptera	NA	P
Zygoptera		
Zygoptera	NA	P
Aeshnidae		
Boyeria grafiana	3	P
Boyeria vinosa	2	P
Calopterygidae		
Calopteryx spp.	5	P
Hetaerina spp.	6	P
Calopterygidae	5	P
Coenagrionidae		
Argia spp.	8	P
Coenagrion/*Enallagma* gp.	8	P
Enallagma spp.	6	P
Ischnura	7	P
Coenagrionidae	9	P
Cordulegastridae		
Cordulegaster spp.	3	P

Table 1. Cont.

TAXON	Tolerance Value	FFG
Corduliidae		
Epitheca spp.	7	P
Helocordulia	5	P
Neurcordulia spp.	5	P
Somatochlora spp.	1	P
Corduliidae	5	P
Gomphidae		
Dromogomphus spp.	4	P
Gomphus spp.	7	P
Hagenius brevistylus	2	P
Ophiogomphus spp.	2	P
Progomphus spp.	5	P
Stylogomphus albistylus	0	P
Gomphidae	1	P
Lestidae		
Archilestes spp.	1	P
Libellulidae		
Erythemis spp.	5	P
Libellula spp.	8	P
Pachydiplax spp.	8	P
Plathemis spp.	3	P
Libellulidae	9	P
Macromiidae		
Didymops spp.	4	P
Macromia spp.	3	P
Plecoptera		
Plecoptera		
Plecoptera	NA	NA
Capniidae		
Allocapnia spp.	2	SH
Capniidae	1	SH
Chloroperlidae		
Haploperla spp.	1	SC
Leuctridae		
Leuctridae	0	SH
Peltoperlidae		
Tallopería spp.	2	SH
Peltoperlidae	2	SH
Perlidae		
Acroneuria spp.	1	P
Eccoptura xanthenes	1	P
Neoperla spp.	1	P
Paragnetina spp.	1	P
Perlidae	1	P
Perlodidae		
Clioperla clio	1	P
Isoperla spp.	4	P
Perlodidae	2	P
Pteronarcyidae		
Pteronarcys spp.	2	SH
Taeniopterygidae		
Taeniopteryx spp.	2	SH

Table 1. Cont.

TAXON	Tolerance Value	FFG
Trichoptera		
Trichoptera		
Trichoptera	NA	NA
Brachycentridae		
Brachycentrus spp.	1	FC
Micrasema spp.	2	SH
Calamoceratidae		
Anisocentropus pyraloides	3	SH
Heteroplectron americanum	3	SH
Dipseudopsidae		
Phylocentropus spp.	5	FC
Glossosomatidae		
Glossosoma spp.	0	SC
Glossosomatidae	0	SC
Helicopsychidae		
Helicopsyche borealis	3	SC
Hydropsychidae		
Ceratopsyche bifida gp.	3	FC
Ceratopsyche sparna	1	FC
Cheumatopsyche spp.	6	FC
Hydropsyche depravata gp.	7	FC
Hydropsyche scalaris gp.	4	FC
Hydropsyche spp.	7	FC
Hydropsychidae	4	FC
Hydroptilidae		
Hydroptila spp.	6	PI
Ochrotrichia spp.	4	PI
Leptoceridae		
Ceraclea spp.	3	CG
Mystacides spp.	4	CG
Nectopsyche spp.	3	SH
Oecetis spp.	8	P
Triaenodes spp.	6	SH
Leptoceridae	4	CG
Limnephilidae		
Goera spp.	0	SC
Pycnopsyche spp.	4	SH
Philopotamidae		
Chimarra spp.	4	FC
Dolophilodes spp.	3	FC
Phryganeidae		
Phryganeidae	4	SH
Polycentropodidae		
Cernotina spp.	6	P
Neureclipsis spp.	7	FC
Paranyctiophylax spp.	5	P
Polycentropus spp.	6	FC
Rhyacophilidae		
Rhyacophila carolina gp.	1	P
Rhyacophila invaria gp.	1	P
Rhyacophila nigrita	1	P
Rhyacophila spp.	4	P

Table 1. Cont.

TAXON	Tolerance Value	FFG
OTHER AQUATIC INVERTEBRATES		
Amphipoda		
Amphipoda		
Amphipoda	NA	SH
Gammaridae		
Crangonyx spp.	4	CG
Hyalellidae		
Hyalella azteca	8	CG
Branchiobdellidae		
Branchiobdellidae		
Branchiobdellidae	6	CG
Decapoda		
Cambaridae		
Cambarus spp.	6	CG
Orconectes spp.	6	CG
Cambaridae	5	CG
Gastropoda		
Ancylidae		
Ancylidae	7	SC
Hydrobiidae		
Somatogyrus spp.	8	SC
Lymnaeidae		
Pseudosuccinea collumella	7	SC
Physidae		
Physella spp.	8	NA
Planorbidae		
Helisoma spp.	7	SC
Planorbidae	6	SC
Pleuroceridae		
Elimia spp.	5	SC
Hirudinea		
Hirudinea		
Hirudinea	8	P
Glossiphoniidae		
Helobdella spp.	6	P
Isopoda		
Asellidae		
Caecidotea spp.	8	CG
Lirceus spp.	8	CG
Nematoda		
Nematoda		
Nematoda	5	NA

Table 1. Cont.

TAXON	Tolerance Value	FFG
Nemertea		
Nemertea		
Prostoma spp.	NA	NA
Oligochaeta		
Oligochaeta		
Oligochaeta	10	CG
Lumbriculidae		
Lumbriculidae	8	CG
Naididae		
Dero spp.	10	CG
Stylaria spp.	8	CG
Naididae	8	CG
Tubificidae		
Branchiura sowerbyi	10	CG
Tubificidae	10	CG
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	FC
Sphaeriidae		
Pisidium spp.	8	FC
Sphaeriidae	8	FC
Unionidae		
Quadrula spp.	NA	FC
Turbellaria		
Turbellaria		
Turbellaria	4	NA
Planariidae		
Planariidae	4	NA

[1]Tolerance Values: 0 = intolerant of organic pollution, 10 = tolerant of organic pollution.
[2]FFG = Functional feeding groups: CG=collector/gatherer, P=predator, SH=shredder, SC=scrapper, FC=filtering collector, PI=piercer.

APPENDIX I

Table 2. Benthic macroinvertebrates collected in Choccolocco Creek (site 2), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Macronychus glabratus adults	4	16
Optioservus spp. adults	4	3
Optioservus spp. larvae	4	1
Haliplidae		
Peltodytes spp. adults	5	7
Diptera		
Chironomidae		
Ablabesmyia spp.	8	5
Chironomus spp.	10	2
Cricotopus/Orthocladius	7	2
Cryptochironomus spp.	8	2
Natarsia spp.	8	1
Parakiefferiella spp.	6	1
Paralauterborniella nigrohalteralis	8	1
Phaenopsectra spp.	7	3
Tanytarsus spp.	7	4
Thienemannimyia complex	6	1
Tribelos spp.	5	3
Chironomidae larvae	7	3
Chironomidae pupae	7	2
Empididae		
Hemerodromia spp.	6	1
Simuliidae		
Simulium spp.	6	1
Tipulidae		
Tipula spp.	4	4
Ephemeroptera		
Baetidae		
Baetis spp.	6	2
Baetidae	4	5
Baetiscidae		
Baetisca spp.	5	2
Heptageniidae		
Stenacron spp.	4	1
Stenonema modestum sp.	4	16
Heptageniidae	4	15
Isonychiidae		
Isonychia spp.	3	8
Tricorythidae		
Tricorythodes spp.	5	6
Megaloptera		
Corydalidae		
Corydalus cornutus	6	5
Odonata		
Anisoptera	NA	1
Zygoptera	NA	2
Aeshnidae		
Boyeria vinosa	2	1

Table 2. Continued.

TAXON	Tolerance[1]	Total
Coenagrionidae		
Argia spp.	8	21
Enallagma spp.	6	8
Corduliidae		
Neurcordulia spp.	5	1
Gomphidae		
Gomphus spp.	7	4
Macromiidae		
Macromia spp.	3	20
Plecoptera		
Perlidae		
Paragnetina spp.	1	1
Trichoptera		
Hydropsychidae		
Ceratopsyche sparna	1	1
Cheumatopsyche spp.	6	1
Philopotamidae		
Chimarra spp.	4	1
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	1
Gastropoda		
Pleuroceridae		
Elimia spp.	5	56
Isopoda		
Asellidae		
Caecidotea spp.	8	1
Oligochaeta		
Oligochaeta	10	3
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	69
Turbellaria		
Planariidae	4	2
TOTALS=================>		317

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 3. Benthic macroinvertebrates collected in Choccolocco Creek (site 3), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	4
Dytiscidae		
Uvarus spp. adults	5	12
Elmidae		
Macronychus glabratus adults	4	30
Macronychus glabratus larvae	4	2
Optioservus spp. adults	4	2
Diptera		
Chironomidae		
Chironomus spp.	10	2
Cricotopus tremulus gp.	7	2
Paralauterborniella nigrohalteralis	8	2
Polypedilum (P.) fallax	7	4
Potthastia longimana gp.	4	2
Tanytarsus spp.	7	4
Simuliidae		
Simulium spp.	6	2
Ephemeroptera		
Baetidae		
Baetis spp.	6	16
Baetiscidae		
Baetisca spp.	5	2
Heptageniidae		
Stenacron spp.	4	2
Stenonema spp.	5	24
Isonychiidae		
Isonychia spp.	3	14
Tricorythidae		
Tricorythodes spp.	5	2
Odonata		
Aeshnidae		
Boyeria vinosa	2	2
Coenagrionidae		
Argia spp.	8	26
Gomphidae		
Dromogomphus spp.	4	6
Hagenius brevistylus	2	2
Macromiidae		
Macromia spp.	3	18
Plecoptera		
Perlidae		
Paragnetina spp.	1	4
Trichoptera		
Hydropsychidae		
Ceratopsyche sparna	1	2
Cheumatopsyche spp.	6	4
Hydroptilidae		
Hydroptila spp.	6	2
Leptoceridae		
Oecetis spp.	8	2

Table 3. Continued.

TAXON	Tolerance[1]	Total
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Pleuroceridae		
Elimia spp.	5	74
Oligochaeta		
Tubificidae	10	2
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	22
TOTALS=================>		296

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 4. Benthic macroinvertebrates collected in Choccolocco Creek (site 4), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Dubiraphia spp. adults	6	2
Haliplidae		
Peltodytes spp. adults	5	8
Hydrochidae		
Hydrochus spp. adults	NA	4
Hydrophilidae		
Berosus spp. larvae	5	2
Diptera		
Chironomidae		
Ablabesmyia spp.	8	4
Chironomus spp.	10	2
Clinotanypus spp.	8	2
Dicrotendipes spp.	8	2
Paracladopelma spp.	7	2
Polypedilum (P.) fallax	7	2
Polypedilum (P.) illinoense	6	2
Rheocricotopus spp.	6	2
Stenochironomus spp.	5	6
Tanytarsus spp.	7	2
Chironomidae larvae	7	4
Chironomidae pupae	7	2
Simuliidae		
Simulium spp.	6	2
Ephemeroptera		
Baetidae		
Baetidae	4	20
Heptageniidae		
Stenacron spp.	4	8
Stenonema spp.	5	30
Isonychiidae		
Isonychia spp.	3	30
Tricorythidae		
Tricorythodes spp.	5	10
Megaloptera		
Corydalidae		
Corydalus cornutus	6	14
Odonata		
Coenagrionidae		
Argia spp.	8	12
Enallagma spp.	6	28
Corduliidae	5	2
Odonata		
Gomphidae		
Dromogomphus spp.	4	2
Plecoptera		
Capniidae		
Capniidae	1	2
Perlidae		
Paragnetina spp.	1	2

Table 4. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Hydropsychidae		
Ceratopsyche bifida gp.	3	2
Cheumatopsyche spp.	6	4
Leptoceridae		
Nectopsyche spp.	3	2
OTHER AQUATIC INVERTEBRATES		
Amphipoda		
Gammaridae		
Crangonyx spp.	4	2
Hyalellidae		
Hyalella azteca	8	16
Decapoda		
Cambaridae		
Orconectes spp.	6	2
Gastropoda		
Pleuroceridae		
Elimia spp.	5	60
Oligochaeta		
Lumbriculidae	8	2
Tubificidae	10	2
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	8
TOTALS================>		310

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 5. Benthic macroinvertebrates collected in Choccolocco Creek (site 5), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	2
Hydrophilidae		
Hydrophilidae larvae	5	1
Diptera		
Chironomidae		
Cardiocladius spp.	6	9
Chironomus spp.	10	53
Cricotopus bicinctus	7	4
Cricotopus tremulus gp.	7	9
Cricotopus spp.	7	13
Cricotopus/Orthocladius	7	13
Polypedilum (*P.*) *illinoense*	6	18
Thienemannimyia complex	6	13
Chironomidae pupae	7	4
Simuliidae		
Simulium spp.	6	13
Ephemeroptera		
Baetidae		
Baetis spp.	6	35
Heterocloeon spp.	2	1
Heptageniidae		
Stenacron spp.	4	1
Stenonema mediopunctatum	2	1
Stenonema spp.	5	9
Megaloptera		
Corydalidae		
Corydalus cornutus	6	2
Odonata		
Calopterygidae		
Calopteryx spp.	5	1
Hetaerina spp.	6	1
Coenagrionidae		
Argia spp.	8	2
Plecoptera		
Perlidae		
Paragnetina spp.	1	2
Trichoptera		
Hydropsychidae		
Ceratopsyche sparna	1	1
Cheumatopsyche spp.	6	5
Hydropsychidae	4	4
OTHER AQUATIC INVERTEBRATES		
Gastropoda		
Physidae		
Physella spp.	8	1
Oligochaeta		
Lumbriculidae		
Lumbriculidae	8	3

Table 5. Continued.

TAXON	Tolerance[1]	Total
Naididae		
Dero spp.	10	1
Naididae	8	1
Tubificidae		
Branchiura sowerbyi	10	6
Tubificidae	10	4
TOTALS================>		233

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 6. Benthic macroinvertebrates collected in Choccolocco Creek (site 6), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	1
Elmidae		
Dubiraphia spp. adults	6	3
Macronychus glabratus adults	4	3
Hydrophilidae		
Berosus spp. larvae	5	6
Diptera		
Ceratopogonidae		
Ceratopogonidae	6	1
Chironomidae		
Cardiocladius spp.	6	10
Chironomus spp.	10	17
Cricotopus bicinctus	7	20
Cricotopus tremulus gp.	7	20
Cricotopus spp.	7	3
Cricotopus/*Orthocladius*	7	17
Paralauterborniella nigrohalteralis	8	3
Thienemannimyia complex	6	10
Chironomidae pupae	7	6
Empididae		
Hemerodromia spp.	6	1
Ephemeroptera		
Baetidae		
Baetis spp.	6	18
Heptageniidae		
Stenonema spp.	5	2
Tricorythidae		
Tricorythodes spp.	5	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	23
Odonata		
Calopterygidae		
Hetaerina spp.	6	2
Coenagrionidae		
Argia spp.	8	23
Enallagma spp.	6	14
Libellulidae		
Plathemis spp.	3	1
Plecoptera		
Plecoptera	NA	1
Trichoptera		
Brachycentridae		
Brachycentrus spp.	1	1
Hydropsychidae		
Cheumatopsyche spp.	6	6
Hydropsyche depravata gp.	7	2
Hydropsychidae	4	2
Leptoceridae		
Triaenodes spp.	6	1

Table 6. Continued.

TAXON	Tolerance[1]	Total
OTHER AQUATIC INVERTEBRATES		
Amphipoda		
Amphipoda	NA	1
Hyalellidae		
Hyalella azteca	8	3
Decapoda		
Cambaridae	5	4
Gastropoda		
Physidae		
Physella spp.	8	1
Hirudinea	8	1
Oligochaeta	10	14
TOTALS=================>		243

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 7. Benthic macroinvertebrates collected in Choccolocco Creek (site 7), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Microcylloepus spp. larvae	4	2
Haliplidae		
Peltodytes spp. adults	5	2
Hydrophilidae		
Berosus spp. larvae	5	2
Diptera		
Diptera larvae	NA	4
Chironomidae		
Cardiocladius spp.	6	3
Chironomus spp.	10	50
Cricotopus bicinctus	7	9
Cricotopus tremulus gp.	7	5
Cricotopus/Orthocladius	7	3
Cryptochironomus spp.	8	3
Polypedilum (*P.*) *illinoense*	6	3
Chironomidae pupae	7	4
Simuliidae		
Simulium spp.	6	42
Simuliidae pupae	6	2
Tipulidae		
Tipula spp.	4	2
Ephemeroptera		
Baetidae		
Baetis spp.	6	12
Baetidae	4	4
Heptageniidae		
Stenonema mediopunctatum	2	10
Stenonema spp.	5	2
Tricorythidae		
Tricorythodes spp.	5	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	26
Odonata		
Aeshnidae		
Boyeria vinosa	2	2
Calopterygidae		
Hetaerina spp.	6	6
Coenagrionidae		
Argia spp.	8	6
Enallagma spp.	6	4
Coenagrionidae	9	2
Corduliidae		
Epitheca spp.	7	2
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	12
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	4

Table 7. Continued.

TAXON	Tolerance[1]	Total
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	10
Planorbidae		
Helisoma spp.	7	36
Pleuroceridae		
Elimia spp.	5	28
Hirudinea		
Hirudinea	8	2
Glossiphoniidae		
Helobdella spp.	6	14
Isopoda		
Asellidae		
Caecidotea spp.	8	4
Oligochaeta		
Oligochaeta	10	40
Naididae		
Dero spp.	10	2
Pelecypoda		
Sphaeriidae	8	4
Turbellaria		
Planariidae	4	14
TOTALS================>		384

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

Table 8. Benthic macroinvertebrates collected in Choccolocco Creek (site 8), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Uvarus spp. adults	5	4
Elmidae		
Microcylloepus spp. adults	2	4
Microcylloepus spp. larvae	4	2
Stenelmis spp. adults	7	2
Stenelmis spp. larvae	7	2
Elmidae larvae	5	2
Hydrophilidae		
Berosus spp. larvae	5	6
Psephenidae		
Psephenus herricki larvae	4	2
Diptera		
Chironomidae		
Cardiocladius spp.	6	9
Chironomus spp.	10	9
Clinotanypus spp.	8	3
Cricotopus bicinctus	7	6
Cricotopus spp.	7	3
Cricotopus/Orthocladius	7	9
Cryptotendipes spp.	6	3
Dicrotendipes spp.	8	3
Polypedilum (P.) convictum	7	3
Polypedilum (P.) fallax	7	3
Polypedilum (P.) illinoense	6	35
Tanytarsus spp.	7	6
Chironomidae pupae	7	6
Ephemeroptera		
Baetidae		
Baetis spp.	6	12
Heptageniidae		
Stenonema exiguum	5	4
Stenonema mediopunctatum	2	88
Stenonema spp.	5	24
Isonychiidae		
Isonychia spp.	3	2
Tricorythidae		
Tricorythodes spp.	5	30
Hemiptera		
Corixidae	NA	2
Mesoveliidae		
Mesovelia spp.	NA	2
AQUATIC INSECTS		
Megaloptera		
Corydalidae		
Corydalus cornutus	6	82
Odonata		
Coenagrionidae		
Argia spp.	8	20
Enallagma spp.	6	6
Trichoptera		
Glossosomatidae	0	2

Table 8. Continued.

TAXON	Tolerance[1]	Total
Hydropsychidae		
Ceratopsyche bifida gp.	3	24
Cheumatopsyche spp.	6	22
Hydropsyche depravata gp.	7	2
Hydropsychidae	4	6
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	4
Physidae		
Physella spp.	8	2
Planorbidae		
Helisoma spp.	7	8
Pleuroceridae		
Elimia spp.	5	24
Oligochaeta		
Lumbriculidae	8	22
Tubificidae	10	2
Turbellaria		
Planariidae	4	6
TOTALS================>		520

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 9. Benthic macroinvertebrates collected in Snow Creek (site 10), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Laccophilus adults	5	1
Diptera		
Chironomidae		
Ablabesmyia spp.	8	4
Chironomus spp.	10	90
Cricotopus bicinctus	7	4
Goeldichironomus spp.	8	4
Polypedilum (*P.*) *illinoense*	6	4
Thienemannimyia complex	6	22
Chironomidae pupae	7	5
Culicidae		
Culex spp.	8	5
Sciomyzidae		
Dictya spp.	10	2
Tabanidae		
Tabanus-Whitneyomyia-Atylotus gp.	7	2
Tipulidae		
Tipula spp.	4	1
Odonata		
Aeshnidae		
Boyeria grafiana	3	1
Boyeria vinosa	2	1
Coenagrionidae		
Argia spp.	8	56
Corduliidae		
Somatochlora spp.	1	1
Lestidae		
Archilestes spp.	1	3
Libellulidae		
Pachydiplax spp.	8	1
Plathemis spp.	3	3
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Physidae		
Physella spp.	8	19
Hirudinea		
Glossiphoniidae		
Helobdella spp.	6	1
Oligochaeta		
Oligochaeta	10	5
Tubificidae	10	10
TOTALS================>		247

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 10. Benthic macroinvertebrates collected in Snow Creek (site 11), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Laccophilus adults	5	2
Diptera		
Chironomidae		
Cricotopus bicinctus	7	28
Cricotopus tremulus gp.	7	15
Cricotopus/Orthocladius	7	5
Polypedilum (P.) illinoense	6	3
Thienemannimyia complex	6	25
Chironomidae pupae	7	6
Empididae		
Hemerodromia spp.	6	2
Stratiomyidae		
Stratiomys spp.	10	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	2
Odonata		
Aeshnidae		
Boyeria vinosa	2	2
Coenagrionidae		
Argia spp.	8	2
Gomphidae		
Progomphus spp.	5	6
Libellulidae		
Plathemis spp.	3	68
Libellulidae	9	10
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae		
Cambaridae	5	40
Gastropoda		
Physidae		
Physella spp.	8	6
Oligochaeta		
Oligochaeta	10	10
Tubificidae		
Branchiura sowerbyi	10	2
Tubificidae	10	50
TOTALS=================>		286

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 11. Benthic macroinvertebrates collected in Snow Creek (site 12), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Haliplidae		
Peltodytes spp. adults	5	2
Hydrophilidae		
Berosus spp. larvae	5	2
Tropisternus spp. adults	5	1
Ptilodactylidae		
Anchytarsus bicolor larvae	5	1
Diptera		
Chironomidae		
Cricotopus bicinctus	7	53
Cricotopus tremulus gp.	7	53
Cricotopus/Orthocladius	7	9
Polypedilum (P.) convictum	7	5
Thienemannimyia complex	6	13
Chironomidae pupae	7	5
Empididae		
Hemerodromia spp.	6	1
Empididae pupae	6	1
Ephemeroptera		
Baetidae		
Paracloeodes spp.	4	12
Megaloptera		
Corydalidae		
Corydalus cornutus	6	3
Odonata		
Calopterygidae		
Calopteryx spp.	5	1
Coenagrionidae		
Argia spp.	8	52
Coenagrion/Enallagma gp.	8	1
Coenagrionidae	9	1
Libellulidae		
Plathemis spp.	3	4
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	1
Gastropoda		
Physidae		
Physella spp.	8	29
Oligochaeta	10	2
Tubificidae		
Branchiura sowerbyi	10	1
Tubificidae	10	1
TOTALS================>		254

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 12. Benthic macroinvertebrates collected in Snow Creek (site 13), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Diptera		
Chironomidae		
Ablabesmyia spp.	8	3
Cricotopus bicinctus	7	26
Cricotopus tremulus gp.	7	3
Cricotopus/Orthocladius	7	10
Larsia spp.	6	3
Nanocladius spp.	3	13
Polypedilum (*P.*) *illinoense*	6	20
Thienemannimyia complex	6	20
Chironomidae pupae	7	12
Simuliidae		
Simulium spp.	6	4
Tabanidae		
Tabanus-Whitneyomyia-Atylotus gp.	7	1
Ephemeroptera		
Baetidae		
Baetidae	4	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	4
Odonata		
Coenagrionidae		
Argia spp.	8	1
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	1
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	2
Physidae		
Physella spp.	8	2
Hirudinea	8	1
Oligochaeta		
Lumbriculidae	8	1
Tubificidae	10	6
Turbellaria		
Planariidae	4	1
TOTALS=================>		138

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 13. Benthic macroinvertebrates collected in Terrapin Creek (Site 14), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Macronychus glabratus adults	4	5
Optioservus spp. adults	4	1
Optioservus spp. larvae	4	6
Stenelmis spp. adults	7	17
Stenelmis spp. larvae	7	11
Psephenidae		
Psephenus herricki larvae	4	1
Diptera		
Athericidae		
Atherix lantha	2	23
Chironomidae		
Ablabesmyia spp.	8	2
Cricotopus tremulus gp.	7	1
Lopescladius spp.	6	1
Nanocladius spp.	3	1
Nilotanypus spp.	6	1
Polypedilum (I.) halterale	7	7
Procladius spp.	9	2
Tanytarsus spp.	7	8
Tribelos spp.	5	2
Tvetenia discoloripes gp.	5	1
Chironomidae	7	2
Chironomidae pupae	7	1
Simuliidae		
Simulium spp.	6	5
Tipulidae		
Tipula spp.	4	1
Ephemeroptera		
Baetidae		
Baetis spp.	6	15
Baetiscidae		
Baetisca spp.	5	2
Ephemerellidae		
Eurylophella spp.	6	1
Ephemeridae		
Hexagenia spp.	6	11
Heptageniidae		
Stenacron spp.	4	1
Stenonema spp.	5	36
Isonychiidae		
Isonychia spp.	3	54
Megaloptera		
Corydalidae		
Corydalus cornutus	6	26
Sialidae		
Sialis spp.	4	4
Odonata		
Coenagrionidae		
Argia spp.	8	12

Table 14. Continued.

TAXON	Tolerance[1]	Total
Gomphidae		
Dromogomphus spp.	4	8
Hagenius brevistylus	2	1
Ophiogomphus spp.	2	1
Gomphidae	1	1
Macromiidae		
Didymops spp.	4	2
Macromia spp.	3	12
Plecoptera		
Perlidae		
Paragnetina spp.	1	1
Trichoptera		
Hydropsychidae		
Ceratopsyche sparna	1	3
Cheumatopsyche spp.	6	22
Hydropsyche spp.	7	1
Philopotamidae		
Chimarra spp.	4	27
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	9
Gastropoda		
Pleuroceridae		
Elimia spp.	5	22
Oligochaeta		
Tubificidae	10	8
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	6
TOTALS=================>		385

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 14. Benthic macroinvertebrates collected in Choccolocco Creek (site 15), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Ancyronyx variegatus adults	6	1
Dubiraphia spp. adults	6	1
Macronychus glabratus adults	4	3
Optioservus spp. adults	4	1
Gyrinidae		
Gyrinus spp. adults	4	1
Psephenidae		
Psephenus herricki larvae	4	15
Diptera		
Chironomidae		
Ablabesmyia spp.	8	1
Microtendipes rydalensis gp.	6	1
Nanocladius spp.	3	2
Polypedilum (P.) convictum	7	1
Polypedilum spp.	6	4
Procladius spp.	9	1
Rheocricotopus spp.	6	1
Tribelos spp.	5	2
Xylotopus par	2	1
Chironomidae pupae	7	2
Culicidae		
Anopheles spp.	6	1
Dixidae		
Dixella spp.	1	4
Simuliidae		
Simulium spp.	6	1
Tipulidae		
Hexatoma spp.	4	10
Tipula spp.	4	2
Ephemeroptera		
Baetidae		
Baetis spp.	6	7
Baetidae	4	1
Baetiscidae		
Baetisca spp.	5	3
Ephemeridae		
Ephemera spp.	4	3
Heptageniidae		
Stenacron spp.	4	4
Stenonema modestum gp.	4	1
Stenonema spp.	5	25
Isonychiidae		
Isonychia spp.	3	14
Hemiptera	NA	1
Megaloptera		
Corydalidae		
Nigronia serricornis	2	8
Sialidae		
Sialis spp.	4	2
Odonata		
Calopterygidae		
Calopteryx spp.	5	3

Table 14. Continued.

TAXON	Tolerance[1]	Total
Cordulegastridae		
Cordulegaster spp.	3	3
Corduliidae		
Helocordulia	5	2
Corduliidae	5	6
Gomphidae		
Dromogomphus spp.	4	10
Ophiogomphus spp.	2	1
Gomphidae	1	23
Macromiidae		
Macromia spp.	3	4
Plecoptera		
Peltoperlidae		
Talloperla spp.	2	6
Perlidae		
Acroneuria spp.	1	19
Neoperla spp.	1	4
Perlidae	1	3
Pteronarcyidae		
Pteronarcys spp.	2	3
Trichoptera	NA	3
Calamoceratidae		
Anisocentropus pyraloides	3	1
Dipseudopsidae		
Phylocentropus spp.	5	2
Helicopsychidae		
Helicopsyche borealis	3	1
Hydropsychidae		
Cheumatopsyche spp.	6	9
OTHER AQUATIC INVERTEBRATES		
Gastropoda		
Pleuroceridae		
Elimia spp.	5	48
Oligochaeta	10	2
Pelecypoda		
Unionidae		
Quadrula spp.	NA	1
TOTALS================>		279

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 15. Benthic macroinvertebrates collected in the South Fork of Terrapin Creek (site 16), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	3
Elmidae		
Dubiraphia spp. adults	6	1
Optioservus spp. adults	4	1
Stenelmis spp. adults	7	3
Stenelmis spp. larvae	7	3
Psephenidae		
Ectopria spp. larvae	5	4
Psephenus herricki larvae	4	2
Ptilodactylidae		
Anchytarsus bicolor larvae	5	47
Diptera		
Athericidae		
Atherix lantha	2	1
Chironomidae		
Ablabesmyia spp.	8	3
Nanocladius spp.	3	1
Parametriocnemus spp.	5	1
Polypedilum (P.) fallax	7	1
Stenochironomus spp.	5	1
Tanytarsus spp.	7	5
Culicidae		
Anopheles spp.	6	1
Dixidae		
Dixella spp.	1	2
Simuliidae		
Simulium spp.	6	5
Tabanidae		
Tabanus-Whitneyomyia-Atylotus gp.	7	1
Tipulidae		
Hexatoma spp.	4	6
Ephemeroptera		
Baetidae		
Baetidae	4	1
Baetiscidae		
Baetisca spp.	5	1
Heptageniidae		
Stenacron spp.	4	25
Stenonema spp.	5	45
Isonychiidae		
Isonychia spp.	3	1
Leptophlebiidae	2	3
Megaloptera		
Corydalidae		
Nigronia serricornis	2	8
Sialidae		
Sialis spp.	4	1
Odonata		
Aeshnidae		
Boyeria vinosa	2	1
Calopterygidae		
Calopteryx spp.	5	8

Table 15. Continued.

TAXON	Tolerance[1]	Total
Cordulegastridae		
Cordulegaster spp.	3	9
Gomphidae		
Stylogomphus albistylus	0	1
Gomphidae	1	3
Macromiidae		
Macromia spp.	3	1
Plecoptera		
Perlidae		
Acroneuria spp.	1	14
Eccoptura xanthenes	1	6
Perlidae	1	15
Trichoptera		
Calamoceratidae		
Heteroplectron americanum	3	1
Hydropsychidae		
Cheumatopsyche spp.	6	21
Hydropsyche depravata gp.	7	2
Leptoceridae		
Ceraclea spp.	3	1
Philopotamidae		
Chimarra spp.	4	32
Polycentropodidae		
Cernotina spp.	6	1
Rhyacophilidae		
Rhyacophila spp.	4	1
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae		
Cambarus spp.	6	1
Cambaridae	5	5
Gastropoda		
Pleuroceridae		
Elimia spp.	5	19
Isopoda		
Asellidae		
Caecidotea spp.	8	23
TOTALS=================>		342

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 16. Benthic macroinvertebrates collected in Choccolocco Creek (site 2), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Uvarus spp. adults	5	2
Elmidae		
Macronychus glabratus adults	4	2
Macronychus glabratus larvae	4	2
Optioservus spp. adults	4	14
Optioservus spp. larvae	4	4
Diptera		
Chironomidae		
Chironomus spp.	10	4
Clinotanypus spp.	8	2
Cricotopus bicinctus	7	10
Cricotopus/Orthocladius	7	4
Nanocladius spp.	3	2
Paralauterborniella nigrohalteralis	8	2
Tanytarsus spp.	7	2
Tribelos spp.	5	28
Chironomidae larvae	7	2
Ephemeroptera		
Baetidae		
Paracloeodes spp.	4	10
Baetidae	4	6
Baetiscidae		
Baetisca spp.	5	4
Heptageniidae		
Stenonema mediopunctatum	2	58
Stenonema modestum gp.	4	24
Isonychiidae		
Isonychia spp.	3	22
Hemiptera		
Corixidae	NA	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	12
Odonata		
Calopterygidae		
Calopteryx spp.	5	4
Coenagrionidae		
Argia spp.	8	28
Gomphidae		
Dromogomphus spp.	4	6
Macromiidae		
Macromia spp.	3	32
Plecoptera		
Perlidae		
Paragnetina spp.	1	2
Taeniopterygidae		
Taeniopteryx spp.	2	18

Table 16. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	26
Hydropsyche spp.	7	6
Leptoceridae		
Nectopsyche spp.	3	2
Limnephilidae		
Goera spp.	0	2
Philopotamidae		
Chimarra spp.	4	8
Polycentropodidae		
Polycentropus spp.	6	2
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Pleuroceridae		
Elimia spp.	5	48
Isopoda		
Asellidae		
Caecidotea spp.	8	2
Nemertea		
Nemertea		
Prostoma spp.	NA	4
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	46
TOTALS=================>		456

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 17. Benthic macroinvertebrates collected in Choccolocco Creek (site 3), October 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Coptotomus spp. adults	5	2
Elmidae		
Macronychus glabratus adults	4	16
Macronychus glabratus larvae	4	2
Optioservus spp. adults	4	4
Hydrophilidae		
Sperchopsis tessellatus larvae	5	2
Diptera		
Chironomidae		
Corynoneura spp.	7	2
Cricotopus bicinctus	7	10
Cricotopus/Orthocladius	7	2
Parakiefferiella spp.	6	4
Rheocricotopus spp.	6	2
Simuliidae		
Simulium spp.	6	24
Tipulidae		
Tipula spp.	4	6
Tipulidae	3	4
Ephemeroptera		
Baetidae		
Baetis spp.	6	36
Baetidae	4	2
Baetiscidae		
Baetisca spp.	5	2
Heptageniidae		
Stenonema mediopunctatum	2	20
Stenonema spp.	5	32
Isonychiidae		
Isonychia spp.	3	18
Hemiptera		
Corixidae	NA	4
Odonata		
Aeshnidae		
Boyeria vinosa	2	2
Calopterygidae		
Calopteryx spp.	5	2
Coenagrionidae		
Argia spp.	8	6
Corduliidae		
Neurcordulia spp.	5	2
Gomphidae		
Progomphus spp.	5	2
Gomphidae	1	2
Macromiidae		
Macromia spp.	3	56
Plecoptera		
Taeniopterygidae		
Taeniopteryx spp.	2	44

Table 17. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Dipseudopsidae		
Phylocentropus spp.	5	2
Leptoceridae		
Triaenodes spp.	6	2
OTHER AQUATIC INVERTEBRATES		
Gastropoda		
Pleuroceridae		
Elimia spp.	5	58
Isopoda		
Asellidae		
Caecidotea spp.	8	2
Lirceus spp.	8	2
Nemertea		
Nemertea		
Prostoma spp.	NA	2
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	16
Turbellaria		
Planariidae	4	2
TOTALS================>		396

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 18. Benthic macroinvertebrates collected in Choccolocco Creek (site 4), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	1
Elmidae		
Dubiraphia spp. larvae	6	1
Macronychus glabratus adults	4	1
Optioservus spp. larvae	4	1
Haliplidae		
Peltodytes spp. adults	5	1
Peltodytes spp. larvae	5	1
Hydrophilidae		
Berosus spp. larvae	5	1
Psephenidae		
Psephenus herricki larvae	4	1
Diptera		
Ceratopogonidae	6	2
Chironomidae		
Ablabesmyia spp.	8	1
Clinotanypus spp.	8	1
Cricotopus bicinctus	7	1
Cricotopus tremulus gp.	7	1
Cricotopus/Orthocladius	7	4
Eukiefferiella claripennis gp.	8	1
Nanocladius spp.	3	4
Orthocladius spp.	6	1
Parakiefferiella spp.	6	2
Polypedilum (I.) scalaenumgp.	7	1
Psectrocladius spp.	8	2
Stenochironomus spp.	5	1
Stictochironomus divinctus	9	1
Simuliidae		
Simulium spp.	6	27
Tipulidae		
Antocha spp.	5	1
Tipula spp.	4	2
Ephemeroptera		
Baetidae		
Baetis spp.	6	20
Baetidae	4	6
Ephemerellidae	1	2
Heptageniidae		
Stenacron spp.	4	13
Stenonema mediopunctatum	2	22
Isonychiidae		
Isonychia spp.	3	48
Hemiptera		
Corixidae		
Palmacorixa spp.	NA	1
Nepidae		
Ranatra spp.	NA	1

Table 18. Continued.

TAXON	Tolerance[1]	Total
Megaloptera		
Corydalidae		
Corydalus cornutus	6	8
Sialidae		
Sialis spp.	4	1
Odonata		
Aeshnidae		
Boyeria vinosa	2	2
Calopterygidae		
Calopteryx spp.	5	1
Coenagrionidae		
Argia spp.	8	10
Enallagma spp.	6	8
Gomphidae		
Dromogomphus spp.	4	1
Ophiogomphus spp.	2	1
Macromiidae		
Macromia spp.	3	6
Plecoptera		
Capniidae		
Allocapnia spp.	2	9
Perlidae		
Acroneuria spp.	1	1
Paragnetina spp.	1	2
Taeniopterygidae		
Taeniopteryx spp.	2	11
Trichoptera		
Hydropsychidae		
Ceratopsyche bifida gp.	3	2
Ceratopsyche sparna	1	1
Cheumatopsyche spp.	6	2
Hydropsychidae	4	1
Polycentropodidae		
Cernotina spp.	6	1
OTHER AQUATIC INVERTEBRATES		
Amphipoda		
Gammaridae		
Crangonyx spp.	4	2
Hyalellidae		
Hyalella azteca	8	2
Gastropoda		
Hydrobiidae		
Somatogyrus spp.	8	3
Lymnaeidae		
Pseudosuccinea collumella	7	2
Physidae		
Physella spp.	8	3
Planorbidae	6	1
Pleuroceridae		
Elimia spp.	5	53
Isopoda		
Asellidae		
Caecidotea spp.	8	1
Lirceus spp.	8	3

Table 18. Continued.

TAXON	Tolerance[1]	Total
Oligochaeta	10	6
Lumbriculidae	8	2
Naididae		
Stylaria spp.	8	1
Tubificidae		
Branchiura sowerbyi	10	1
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	26
TOTALS================>		348

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 19. Benthic macroinvertebrates collected in Choccolocco Creek (site 5), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	1
Dytiscidae		
Uvarus spp. adults	5	1
Elmidae		
Macronychus glabratus adults	4	2
Stenelmis spp. larvae	7	1
Hydrophilidae		
Berosus spp. larvae	5	6
Diptera		
Ceratopogonidae		
Ceratopogonidae	6	1
Chironomidae		
Ablabesmyia spp.	8	3
Chironomus spp.	10	3
Corynoneura spp.	7	3
Cricotopus bicinctus	7	13
Cricotopus tremulus gp.	7	19
Cricotopus/Orthocladius	7	11
Nanocladius spp.	3	3
Thienemannimyia complex	6	27
Chironomidae pupae	7	4
Simuliidae		
Simulium spp.	6	2
Tipulidae		
Tipula spp.	4	1
Ephemeroptera		
Baetidae		
Baetis spp.	6	16
Heptageniidae		
Stenonema mediopunctatum	2	5
Stenonema spp.	5	1
Isonychiidae		
Isonychia spp.	3	1
Megaloptera		
Corydalidae		
Corydalus cornutus	6	1
Nigronia serricornis	2	1
Plecoptera		
Capniidae		
Capniidae	1	3
Perlidae		
Paragnetina spp.	1	1
Taeniopterygidae		
Taeniopteryx spp.	2	14
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	2
Hydropsychidae	4	1
Hydroptilidae		
Hydroptila spp.	6	1
Polycentropodidae		
Neureclipsis spp.	7	1

Table 19. Continued.

TAXON	Tolerance[1]	Total
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	5
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	1
Oligochaeta	10	29
Lumbriculidae	8	4
Tubificidae		
Branchiura sowerbyi	10	11
Tubificidae	10	6
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	2
TOTALS=================>		207

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 20. Benthic macroinvertebrates collected in Choccolocco Creek (site 6), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Optioservus spp. larvae	4	1
Haliplidae		
Peltodytes spp. adults	5	1
Hydrophilidae		
Berosus spp. larvae	5	1
Diptera		
Chironomidae		
Chironomus spp.	10	3
Cricotopus bicinctus	7	12
Cricotopus tremulus gp.	7	46
Cricotopus/*Orthocladius*	7	14
Polypedilum (*P*.) *fallax*	7	6
Thienemannimyia complex	6	6
Chironomidae pupae	7	1
Simuliidae		
Simulium spp.	6	1
Ephemeroptera		
Baetidae		
Baetis spp.	6	10
Baetidae	4	1
Heptageniidae		
Stenonema mediopunctatum	2	2
Stenonema spp.	5	4
Megaloptera		
Corydalidae		
Corydalus cornutus	6	6
Odonata		
Calopterygidae		
Calopteryx spp.	5	2
Coenagrionidae		
Argia spp.	8	6
Ischnura	7	1
Gomphidae		
Dromogomphus spp.	4	1
Libellulidae	9	1
Plecoptera		
Capniidae	1	1
Taeniopterygidae		
Taeniopteryx spp.	2	8
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	2
Hydropsyche scalaris gp.	4	3
Hydropsyche spp.	7	3

Table 20. Continued.

TAXON	Tolerance[1]	Total
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	7
Hirudinea	8	1
TOTALS=================>		151

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

Table 21. Benthic macroinvertebrates collected in Choccolocco Creek (site 7), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Haliplidae		
Peltodytes spp. adults	5	1
Hydrophilidae		
Berosus spp. larvae	5	1
Diptera		
Chironomidae		
Ablabesmyia spp.	8	3
Chironomus spp.	10	6
Clinotanypus spp.	8	9
Cricotopus bicinctus	7	43
Cricotopus/Orthocladius	7	6
Nanocladius spp.	3	3
Procladius spp.	9	15
Psectrocladius spp.	8	3
Thienemannimyia complex	6	3
Tipulidae		
Tipula spp.	4	8
Ephemeroptera		
Baetidae		
Baetis spp.	6	18
Heptageniidae		
Stenacron spp.	4	7
Stenonema mediopunctatum	2	7
Stenonema spp.	5	1
Tricorythidae		
Tricorythodes spp.	5	3
Hemiptera		
Corixidae	NA	3
Lepidoptera		
Pyralidae		
Parapoynx spp.	5	1
Megaloptera		
Corydalidae		
Corydalus cornutus	6	14
Nigronia serricornis	2	1
Odonata		
Aeshnidae		
Boyeria vinosa	2	1
Calopterygidae	5	1
Coenagrionidae		
Argia spp.	8	8
Enallagma spp.	6	9
Gomphidae		
Dromogomphus spp.	4	1

Table 21. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Hydropsychidae		
Ceratopsyche bifida gp.	3	1
Cheumatopsyche spp.	6	36
Hydropsyche depravata gp.	7	23
Hydropsyche scalaris gp.	4	16
Hydropsychidae	4	13
Hydroptilidae		
Hydroptila spp.	6	1
Polycentropodidae		
Neureclipsis spp.	7	2
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	8
Gastropoda		
Ancylidae		
Ancylidae	7	2
Lymnaeidae		
Pseudosuccinea collumella	7	17
Planorbidae		
Helisoma spp.	7	9
Pleuroceridae		
Elimia spp.	5	6
Hirudinea	8	9
Isopoda		
Asellidae		
Caecidotea spp.	8	8
Nemertea		
Nemertea		
Prostoma spp.	NA	2
Oligochaeta	10	9
Lumbriculidae	8	2
Pelecypoda		
Sphaeriidae	8	3
TOTALS================>		343

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 22. Benthic macroinvertebrates collected in Choccolocco Creek (site 8), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Uvarus spp. adults	5	2
Elmidae		
Dubiraphia spp. larvae	6	2
Hydrophilidae		
Berosus spp. larvae	5	4
Psephenidae		
Psephenus herricki larvae	4	2
Diptera		
Chironomidae		
Ablabesmyia spp.	8	2
Cardiocladius spp.	6	2
Chironomus spp.	10	4
Cricotopus tremulus gp.	7	2
Cricotopus spp.	7	2
Cricotopus/Orthocladius	7	12
Cryptochironomus spp.	8	2
Orthocladius spp.	6	2
Parakiefferiella spp.	6	4
Polypedilum (P.) convictum	7	2
Polypedilum (P.) fallax	7	10
Polypedilum (P.) illinoense	6	8
Pseudochironomus spp.	5	2
Tribelos spp.	5	4
Sciomyzidae		
Sciomyzidae larvae	10	2
Simuliidae		
Simulium spp.	6	8
Tipulidae		
Antocha spp.	5	2
Ephemeroptera		
Baetidae		
Baetis spp.	6	36
Heptageniidae		
Stenacron spp.	4	8
Stenonema mediopunctatum	2	80
Stenonema spp.	5	22
Hemiptera		
Corixidae		
Trichocorixa spp.	NA	2
Megaloptera		
Corydalidae		
Corydalus cornutus	6	36
Odonata		
Coenagrionidae		
Argia spp.	8	8
Enallagma spp.	6	2
Macromiidae		
Macromia spp.	3	4

Table 22. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Hydropsychidae		
Ceratopsyche bifida gp.	3	22
Cheumatopsyche spp.	6	30
Hydropsyche depravata gp.	7	6
Hydropsyche scalaris gp.	4	6
Hydropsychidae	4	8
OTHER AQUATIC INVERTEBRATES		
Amphipoda		
Gammaridae		
Crangonyx spp.	4	2
Decapoda		
Cambaridae	5	12
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	6
Physidae		
Physella spp.	8	12
Planorbidae		
Helisoma spp.	7	6
Pleuroceridae		
Elimia spp.	5	4
Isopoda		
Asellidae		
Caecidotea spp.	8	2
Oligochaeta	10	16
Lumbriculidae	8	6
Naididae		
Dero spp.	10	2
Naididae	8	2
Tubificidae	10	2
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	2
Sphaeriidae		
Pisidium spp.	8	2
Turbellaria	4	2
TOTALS================>		428

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 23. Benthic macroinvertebrates collected in Snow Creek (site 10), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Diptera		
Chironomidae		
Chironomus spp.	10	52
Cricotopus bicinctus	7	28
Orthocladius spp.	6	12
Polypedilum (P.) illinoense	6	4
Thienemannimyia complex	6	24
Tipulidae		
Tipula spp.	4	2
Odonata		
Coenagrionidae		
Argia spp.	8	4
Libellulidae		
Plathemis spp.	3	6
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	6
Gastropoda		
Physidae		
Physella spp.	8	52
Oligochaeta		
Oligochaeta	10	12
Lumbriculidae	8	10
Tubificidae	10	42
TOTALS================>		254

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 24. Benthic macroinvertebrates collected in Snow Creek (site 11), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Coptotomus spp. adults	5	1
Hydrophilidae		
Tropisternus spp. larvae	5	1
Diptera		
Chironomidae		
Cricotopus bicinctus	7	7
Cricotopus tremulus gp.	7	20
Cricotopus/Orthocladius	7	22
Thienemannimyia complex	6	5
Chironomidae pupae	7	2
Tipulidae		
Tipula spp.	4	2
Odonata		
Coenagrionidae		
Argia spp.	8	7
Ischnura	7	3
Gomphidae		
Progomphus spp.	5	9
Libellulidae		
Pachydiplax spp.	8	3
Plathemis spp.	3	37
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	40
Gastropoda		
Physidae		
Physella spp.	8	4
Oligochaeta		
Tubificidae		
Branchiura sowerbyi	10	2
Tubificidae	10	4
TOTALS================>		169

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 25. Benthic macroinvertebrates collected in Snow Creek (site 12), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dytiscidae		
Laccophilus adults	5	2
Haliplidae		
Peltodytes spp. adults	5	12
Hydrophilidae		
Berosus spp. larvae	5	6
Tropisternus spp. adults	5	1
Diptera		
Chironomidae		
Cricotopus bicinctus	7	6
Cricotopus tremulus gp.	7	67
Cricotopus/Orthocladius	7	16
Thienemannimyia complex	6	6
Chironomidae pupae	7	3
Empididae		
Hemerodromia spp.	6	3
Tipulidae		
Tipula spp.	4	1
Ephemeroptera		
Baetidae		
Baetis spp.	6	8
Heptageniidae		
Stenonema mediopunctatum	2	1
Hemiptera		
Veliidae		
Microvelia spp.	NA	1
Megaloptera		
Corydalidae		
Corydalus cornutus	6	1
Odonata		
Aeshnidae		
Boveria vinosa	2	1
Coenagrionidae		
Argia spp.	8	69
Coenagrionidae	9	1
Libellulidae		
Erythemis spp.	5	1
Libellula spp.	8	1
Pachydiplax spp.	8	1
Plathemis spp.	3	5
Macromiidae		
Macromia spp.	3	1
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	7
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	5
Physidae		
Physella spp.	8	19

Table 25. Continued.

TAXON	Tolerance[1]	Total
Oligochaeta		
Oligochaeta	10	10
Lumbriculidae	8	4
Tubificidae		
Branchiura sowerbyi	10	2
Tubificidae	10	8
TOTALS=================>		269

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 26. Benthic macroinvertebrates collected in Snow Creek (site 13), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Haliplidae		
Peltodytes spp. adults	5	2
Hydrophilidae		
Berosus spp. larvae	5	3
Diptera		
Chironomidae		
Cricotopus bicinctus	7	17
Cricotopus tremulus gp.	7	41
Cricotopus/Orthocladius	7	24
Thienemannimyia complex	6	21
Chironomidae pupae	7	1
Tipulidae		
Tipula spp.	4	1
Hemiptera		
Veliidae		
Microvelia spp.	NA	2
Odonata		
Coenagrionidae		
Argia spp.	8	21
Ischnura	7	3
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	3
Gastropoda		
Lymnaeidae		
Pseudosuccinea collumella	7	1
Physidae		
Physella spp.	8	1
Nematoda		
Nematoda	5	1
Oligochaeta		
Oligochaeta	10	16
Lumbriculidae	8	2
Tubificidae		
Branchiura sowerbyi	10	4
Tubificidae	10	5
TOTALS================>		169

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 27. Benthic macroinvertebrates collected in Terrapin Creek (site 14), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Elmidae		
Ancyronyx variagatus larvae	6	1
Macronychus glabratus adults	4	1
Microcylloepus spp. adults	2	1
Optioservus spp. adults	4	1
Optioservus spp. larvae	4	4
Stenelmis spp. adults	7	2
Stenelmis spp. larvae	7	5
Diptera		
Athericidae		
Atherix lantha	2	4
Chironomidae		
Corynoneura spp.	7	1
Nanocladius spp.	3	3
Pagastiella ostansa	8	1
Rheocricotopus spp.	6	1
Tanytarsus spp.	7	1
Tvetenia bavarica gp.	5	1
Simuliidae		
Simulium spp.	6	36
Tipulidae		
Tipula spp.	4	2
Tipulidae	3	1
Ephemeroptera		
Baetidae		
Acentrella spp.	5	1
Paracloeodes spp.	4	1
Baetiscidae		
Baetisca spp.	5	9
Ephemerellidae		
Eurylophella spp.	6	16
Heptageniidae		
Stenonema mediopunctatum	2	12
Stenonema modestum gp.	4	45
Isonychiidae		
Isonychia spp.	3	54
Hemiptera		
Veliidae		
Steinovelia spp.	NA	1
Megaloptera		
Corydalidae		
Corydalus cornutus	6	14
Nigronia serricornis	2	2
Odonata		
Coenagrionidae		
Argia spp.	8	11
Corduliidae	5	5
Gomphidae		
Dromogomphus spp.	4	1
Ophiogomphus spp.	2	4
Stylogomphus albistylus	0	1

Table 27. Continued.

TAXON	Tolerance[1]	Total
Plecoptera	NA	4
Capniidae		
Allocapnia spp.	2	33
Peltoperlidae		
Talloperla spp.	2	1
Perlidae		
Acroneuria spp.	1	11
Eccoptura xanthenes	1	1
Perlodidae		
Clioperla clio	1	5
Perlodidae	2	5
Taeniopterygidae		
Taeniopteryx spp.	2	39
Trichoptera		
Brachycentridae		
Brachycentrus spp.	1	1
Hydropsychidae		
Cheumatopsyche spp.	6	15
Leptoceridae		
Mystacides spp.	4	1
Limnephilidae		
Pycnopsyche spp.	4	1
Philopotamidae		
Chimarra spp.	4	16
Dolophilodes spp.	3	1
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	6
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	1
Pleuroceridae		
Elimia spp.	5	13
Hirudinea	8	1
Isopoda		
Asellidae		
Lirceus spp.	8	1
Nemertea		
Nemertea		
Prostoma spp.	NA	1
Oligochaeta		
Tubificidae	10	11
Pelecypoda		
Corbiculidae		
Corbicula fluminea	4	4
TOTALS================>		415

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

Table 28. Benthic macroinvertebrates collected in Choccolocco Creek (site 15), November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	2
Elmidae		
Optioservus spp. adults	4	4
Psephenidae		
Ectopria spp. larvae	5	4
Psephenus herricki larvae	4	18
Diptera		
Athericidae		
Atherix lantha	2	4
Chironomidae		
Cricotopus/Orthocladius	7	2
Epoicocladius spp.	4	2
Nanocladius spp.	3	6
Thienemannimyia complex	6	6
Tvetenia bavarica gp.	5	2
Chironomidae pupae	7	2
Simuliidae		
Simulium spp.	6	10
Tabanidae		
Tabanus spp.	7	2
Tipulidae		
Antocha spp.	5	2
Hexatoma spp.	4	8
Tipula spp.	4	4
Ephemeroptera		
Baetidae		
Baetis spp.	6	2
Baetiscidae		
Baetisca spp.	5	2
Ephemerellidae		
Eurylophella spp.	6	1
Ephemeridae		
Ephemera spp.	4	2
Heptageniidae		
Stenacron spp.	4	8
Stenonema mediopunctatum	2	24
Stenonema spp.	5	6
Isonychiidae		
Isonychia spp.	3	16
Leptophlebiidae	2	4
Megaloptera		
Corydalidae		
Nigronia fasciatus	2	2
Nigronia serricornis	2	6
Sialidae		
Sialis spp.	4	2
Odonata		
Cordulegastridae		
Cordulegaster spp.	3	6
Gomphidae		
Dromogomphus spp.	4	2
Ophiogomphus spp.	2	10
Gomphidae	1	16

Table 28. Continued.

TAXON	Tolerance[1]	Total
Macromiidae		
Macromia spp.	3	14
Plecoptera		
Capniidae		
Allocapnia spp.	2	18
Peltoperlidae		
Talloperla spp.	2	14
Perlidae		
Acroneuria spp.	1	32
Neoperla spp.	1	4
Perlidae	1	6
Pteronarcyidae		
Pteronarcys spp.	2	2
Taeniopterygidae		
Taeniopteryx spp.	2	4
Trichoptera		
Hydropsychidae		
Cheumatopsyche spp.	6	14
Limnephilidae		
Pycnopsyche spp.	4	2
Philopotamidae		
Chimarra spp.	4	2
Dolophilodes spp.	3	4
Polycentropodidae		
Paranyctiophylax spp.	5	2
OTHER AQUATIC INVERTEBRATES		
Decapoda		
Cambaridae	5	2
Gastropoda		
Lymnaeidae		
Pseudosuccinea columella	7	2
Pleuroceridae		
Elimia spp.	5	32
Oligochaeta		
Oligochaeta	10	2
Lumbriculidae	8	2
TOTALS=================>		345

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.

APPENDIX I

Table 29. Benthic macroinvertebrates collected in the South Fork of Terrapin Creek, November 1996.

TAXON	Tolerance[1]	Total
AQUATIC INSECTS		
Coleoptera		
Dryopidae		
Helichus spp. adults	5	2
Ptilodactylidae		
Anchytarsus bicolor larvae	5	40
Diptera		
Chironomidae		
Microtendipes pedellus gp.	6	4
Parachaetocladius spp.	6	4
Parametriocnemus spp.	5	2
Procladius spp.	9	4
Simuliidae		
Simulium spp.	6	6
Tabanidae		
Tabanus-Whitneyomyia-Atylotus gp.	7	2
Tipulidae		
Tipula spp.	4	8
Ephemeroptera		
Heptageniidae		
Stenacron spp.	4	4
Stenonema modestum gp.	4	2
Stenonema spp.	5	18
Isonychiidae		
Isonychia spp.	3	2
Leptophlebiidae	2	2
Megaloptera		
Corydalidae		
Nigronia serricornis	2	6
Odonata		
Aeshnidae		
Boyeria grafiana	3	2
Boyeria vinosa	2	2
Calopterygidae		
Calopteryx spp.	5	6
Coenagrionidae		
Enallagma spp.	6	4
Cordulegastridae		
Cordulegaster spp.	3	6
Corduliidae		
Helocordulia	5	6
Gomphidae		
Dromogomphus spp.	4	8
Stylogomphus albistylus	0	2
Macromiidae		
Macromia spp.	3	2
Plecoptera		
Capniidae	1	4
Leuctridae	0	2
Peltoperlidae	2	6
Perlidae		
Acroneuria spp.	1	10
Eccoptura xanthenes	1	6
Perlidae	1	2

Table 29. Continued.

TAXON	Tolerance[1]	Total
Trichoptera		
Hydropsychidae		
Hydropsyche depravata gp.	7	2
Philopotamidae		
Chimarra spp.	4	28
Dolophilodes spp.	3	4
Rhyacophilidae		
Rhyacophila carolina gp.	1	2
Rhyacophila nigrita	1	6
OTHER AQUATIC INVERTEBRATES		
Gastropoda		
Physidae		
Physella spp.	8	2
Isopoda		
Asellidae		
Lirceus spp.	8	26
Oligochaeta	10	2
TOTALS================>		246

[1]Tolerance = tolerance to organic pollution, 0 - most intolerant to 10 - the most tolerant.