AN EVALUATION OF THE AQUATIC HABITATS PROVIDED BY SEDIMENT CONTROL PONDS AND OTHER AQUATIC ENHANCEMENT STRUCTURES LOCATED ON MINE PERMITTED AREAS IN SOUTHERN WEST VIRGINIA.

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INTRODUCTION

Typically, sediment ditches and diversion ditches are constructed on coal company property for 3 purposes: 1) to divert surface runoff into more desirable locations and away from work areas and roads 2) to combine flows from several sources into fewer, more manageable discharges, and 3) to slow surface runoff, often laden with sediments, to allow for a settling of the sediments to occur prior to flows entering streams. The larger, sediment control ponds are generally constructed on coal company property also for 3 purposes: 1) to slow surface runoff, laden with sediments, in order to allow for settling to occur prior to flows entering streams 2) to provide a flow-control structure which allows the operators to manage downstream stream flows during periods of either very low or very high flows, and 3) to provide a point of chemical/physical treatment in the event the water quality needs to be adjusted prior to entering the lower portions of the stream.

Construction of these sediment ditches, diversion ditches, and sediment control ponds is not something that is performed without giving serious consideration to the natural conditions which exist on the area in question. Design and construction is performed on a case-by-case analysis which includes the natural hydrology, geomorphology, watershed size, and aquatic life inhabiting the stream. In essence, these ponds are nothing short of professionally engineered structures, designed to address the stream flows as well as the surface runoff which can be expected from the watershed size, and are designed to conform to the natural topography of the area.

Although generally these structures are not designed with many aesthetic qualities in mind, the conditions which exist after construction of the ponds and ditches automatically create circumstances necessary for the natural creation of wetlands. The presence of the warmer, slow-moving, sediment-laden water provides the nutrients and sediment sizes necessary for the production of several aquatic emergent and submerged aquatic plants such as cattails, milfoil, rushes, and sedges. The existence of the continuous water overlying the pond's bottom initiates the chain of events necessary for the creation of hydric soils also necessary for aquatic vegetation. In addition, the placement of the designed ponds, usually located directly in the stream channel at the base of a hollow, or on a wide, flat bench where subsurface and surface runoff will support the on-bench pond, are planned so that they are self-sustaining. Water from the stream as well as from surface runoff are adequate to ensure the existence of the pond for decades.

Nevertheless, according to the West Virginia Department of Environmental Protection-Office of Mining and Reclamation, upon completion of mining in the area, the constructed sediment control pond and/or drainage ditches must be removed prior to being released from permitting regulations and receiving back the mining bond. Breaching of the dam is therefore required from the point of view that in order to return the stream back to its original state, the stream channel must be change back to its original shape.

The purpose of this study was to provide an unbiased, professional examination of the sediment control ponds and sediment ditches which currently exist on mine permitted areas in southern West Virginia. Several ponds of various ages would be studied as to their aquatic and wetland status, and usefulness as quality habitats for fauna inhabiting the area.

LOCATION OF STUDY SITES

The overall study area is located in Wayne County, in southwestern West Virginia. Ponds sampled were located on Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3), Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5), and Left Fork of Parker Branch (Pond Number 7). Sediment ditches sampled were located on Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3), Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3), and Left Fork of Parker Branch (Sediment Ditch Number 6).

METHODS OF INVESTIGATION

At each sampled pond or sediment ditch, measurements for physical water quality were taken. Samples were also collected and returned to the laboratory for chemical analysis. Benthic macroinvertebrate samples were also collected, and the habitat of the stations was evaluated. The individual methodologies are described below.

Physical Water Quality/Water Chemistry

Physical water quality was analyzed on-site at each station. Water temperature, Dissolved Oxygen (DO), pH, and conductivity was measured with a Hydrolab™ Minisonde multi-parameter probe.

Water samples were collected at each of the three pond sites as well as the three sediment ditches, appropriately preserved, and transported to R.E.I. Consultant's laboratory for analysis. All analyses utilized current EPA-approved protocols. Parameters measured at each station were Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), hardness, alkalinity, total sulfates, total acidity, sodium, total aluminum, calcium, total iron, total magnesium, total manganese chlorides, fecal coliform, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc.

Habitat

The habitat at each of the sites was assessed, rated, and scored on a few parameters in three categories using EPA Rapid Bioassessment Protocols for Use in Streams and Rivers (EPA 440/4-89/001). Because these parameters were originally developed for streams and rivers, emphasis was placed on the quantity and types of vegetation present, pond/ditch slopes, surface acreage, depth, substrate composition, location of pond/ditch relative to detrimental impacts, and composition of surrounding area (forested, open field, heavy haul traffic area, etc...).

Benthic Macroinvertebrates

At each site, collections were made via a Ponar grab sampler. The Ponar grab sampler has several features which make it a desirable choice for the collection of aquatic macroinvertebrates in lentic habitats such as ponds, lakes, as well as lotic deepwater habitats such as rivers. Sampler area was 81 $inch^2$ per replicate. Three samples were taken near the shoreline, and in the best available spots (lowest siltation, highest percentage of gravel/pebble substrate, highest vegetation) at each station. Samples were placed in 1-gallon plastic containers, preserved in 35% formalin, and returned to the laboratory for processing. Samples were then picked under Unitron™ microscopes and detrital material was discarded only after a second check to insure that no macroinvertebrates had been missed. All macroinvertebrates were identified to lowest practical taxonomic level and enumerated. Metrics were then calculated for each station.

SPECIFIC SITE LOCATIONS / PHYSICAL DESCRIPTIONS

Vance Branch Pond (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3)

This station was located on Vance Branch, and was constructed in 1999 (Figure 1). The pond is approximately 400 feet in length, and is approximately 125 feet wide. At the existing water level, the pond is approximately 300 feet in length, approximately 60 feet wide, and has an area of approximately 0.67 acres. The elevation of the pond's bottom is 984.4 feet above sea level. The existing water depth was only about a foot, but the pond provides for 4.19 acre/feet of accumulative sediment storage. Due to the pond's early completion, the banks were only about 50% vegetated, and this was with various rye and other grasses for erosion control. Aquatic vegetation was minimal except for a small quantity of smartweed (Photographs 1 - 2). The banks were very steep along the hillsides, and were noticeably unstable due to their steepness, lack of vegetation, and composition. Alluvial fans were present from erosion. Adequate soils had not yet formed due to the young age of this structure. This pond had noticeably higher levels of solids (Table 1A) probably due to sediments being washed into the pond easier than at older, more established ponds. There was no pond cover present due to the far distance from the surrounding deciduous forest, and the substrate was comprised mostly of sand and silt (Table 4A).

Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5)

This station was located on Rollem Fork, and was constructed in 1997 (Figure 2). The pond is approximately 200 feet in length, and is approximately 150 feet wide. At the existing water level, the pond is approximately 175 feet in length, approximately 130 feet wide, and has an area of approximately 0.30 acres. The elevation of the pond's bottom is 930.0 feet above sea level. The existing water depth is about 20 feet deep due to the steep slopes (2.1:1) of the side, and the pond provides for 2.70 acre/feet of accumulative sediment storage. Even though the pond was completed in 1997, the banks were almost 100% vegetated (Photographs 3 - 4), and this was with various grasses, herbaceous plants such as St. John's wort, and small saplings such as alder. The banks above water level were not too steep, and were noticeably more stable due to their heavier vegetation. No signs of erosion were present. Soils appeared to be more advanced at this structure. There was only a very little pond cover present from the heavy cattails growing around the pond; there was a far distance from the surrounding deciduous forest. The substrate was comprised mostly of sand and gravel (Table 4A).

Left Fork of Parker Branch (Pond Number 7)

This station was located on the Left Fork of Parker Branch, and was constructed in 1991 (Figure 3). The pond is approximately 160 feet in length, and is approximately 240 feet wide. At the existing water level, the pond is approximately 150 feet in length, approximately 225 feet wide, and has an area of approximately 1.0 acres. The elevation of the pond's bottom is 936.0 feet above sea level. The existing water depth was about 10 feet, and the pond provides for 4.98 acre/feet of accumulative sediment storage. Due to the pond being about 8 years old, the banks were 100% vegetated (Photographs 5 - 6), and this was with various grasses, rushes, golden rod, greenbrier, sycamores. Aquatic vegetation was comprised of milfoil (Myriofyllum sp.), pondweed (Potamogeton sp.), and cattails. The banks were not steep along the hillsides, and were stable due to their low-steepness, heavy vegetation, and soil composition. No signs of erosion were present. There was very little pond cover present due to the far distance from the surrounding deciduous forest, but the heavy vegetation provided some cover along the shoreline areas. The substrate was comprised mostly of silt and sand (Table 4A).

<u>Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3)</u>

This station was located on Vance Branch, and was constructed in 1999 (Figure 4). The combination ditch is approximately 2,250 feet in length, is approximately 41 feet wide, and has an area of approximately 2.12 acres. The elevation of the ditch's bottom is about 1000 feet above sea level. The existing water depth was only about a foot, but the combination ditch provides for 4.28 acre/feet of accumulative sediment storage. Even though the ditch was constructed in 1999, the banks were moderately vegetated, and this was with various rye and clover grasses for erosion control. Aquatic vegetation was minimal except for a small quantity of cattails (Photographs 7 - 8). The banks were not too steep along the hillsides, and were noticeably stable due to their low gradient and vegetation. Soils had not yet established due to the young age of this structure. This sediment ditch had noticeably higher levels of suspended solids (Table 1B) probably due to sediments being washed into the structure easier than at older, more established ones. There was no canopy cover present due to the far distance from the surrounding deciduous forest, and the substrate was comprised mostly of silt and clay (Table 4B).

<u>Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3)</u>

This station was located on Rollem Fork, and was constructed in 1997 (Figure 5). The sediment ditch is approximately 900 feet in length, is approximately 40 feet wide, and has an area of approximately 0.83 acres. The elevation of the ditch's bottom is about 950 feet above sea level. The existing water depth was only about a few inches, but the sediment ditch provides for 1.67 acre/feet of accumulative sediment storage. Even though the ditch was constructed in 1997, the banks were 100% vegetated, and this was with various rye and clover grasses, and sedges. Aquatic vegetation was mostly the large abundance of cattails (Photographs 9 - 10). The banks were not too steep along the hillsides, and were noticeably stable due to their low gradient and vegetation. Soils had established and were noted to be gleyed at about 1.5" within the area of the wetland. There was no canopy cover present due to the far distance from the surrounding deciduous forest, and the substrate was comprised mostly of vegetated silt (Table 4B).

<u>Left Fork of Parker Branch (Sediment Ditch Number 6)</u>

This station was located on the Left Fork of Parker Branch, and was constructed in 1994 (Figure 6). The sediment ditch is approximately 600 feet in length, is approximately 40 feet wide, and has an area of approximately 0.55 acres. The elevation of the ditch's bottom is about 950 feet above sea level. The existing water depth was about 5 feet, and this sediment ditch provides for over 2.5 acre/feet of accumulative sediment storage. The banks were well vegetated, and this was with various rye and clover grasses, sedges, and goldenrod. Aquatic vegetation consisted of cattails, pondweeds (Potamogeton sp.), and water milfoil (Myriophyllum sp.) (Photographs 11 - 12). There was a heavy algae growth which was presumed to be a result of the higher pH level of this structure (Table 1B). The banks were not too steep along the hillsides, and were noticeably stable due to their low gradient and heavy vegetation. Soils were well established due to the older age of this structure. There was no canopy cover present due to the far distance from the surrounding deciduous forest. The substrate was comprised mostly of clay and silt (Table 4B).

PHYSICAL AND CHEMICAL WATER QUALITY ANALYSIS

Physical and chemical water quality was analyzed at each of the pond and sediment ditch sites sampled on Vance Branch, Rollem Fork, and the Left Fork of Parker Branch. The physical and chemical water quality results are presented in Tables 1A and 1B. Many of the ponds had large differences between like parameters. For instance, the pH on Vance Branch's pond was low with a pH of 5.04, whereas the pH for the pond on the Left Fork of Parker Branch was high with a pH of 8.77. The same observation was true with regards to the sediment ditches. For instance, the pH on Rollem Fork's sediment ditch was low with a pH of 5.32, whereas the pH for the sediment ditch on the Left Fork of Parker Branch was high with a pH of 9.39. Most of the chemical values such as dissolved solids, hardness, sulfates, alkalinity, and most metals were considered fairly high. Although several of these values were considered limiting to the benthic macroinvertebrate communities inhabiting them, it should be remembered that one of the primary purposes of the ponds and sediment ditches is for reducing the high levels of solids and metals by settling them out prior to reaching the downstream portions of the receiving streams.

HABITAT ASSESSMENT

Several habitat measurements were determined (Tables 4A and 4B) at each of the sites sampled. The individual parameters are described below.

Pond/Ditch Surface Acreage - Actual size of the structure in acres. Smaller, shallower ponds and ditches, may not last as long or have as much sediment holding potential, but they will have a larger wetland value as there is less open water and more wetland vegetated area.

Length x Width - Longer, narrower ponds and sediment ditches will eventually have better wetland values for filtering incoming waters and provide more useable habitat for aquatic insects than wider, deeper ponds and sediment ditches.

Accumulative Sediment Storage Potential - Amount of sediment the structure can potentially hold. Larger, deeper ponds and sediment ditches can obviously hold more sediments, but may not have as desirable "wetland" potential.

Bottom Substrate Type - The availability of habitat for support of aquatic organisms. A variety of substrate materials and habitat types is desirable. Substrates comprised of more gravel, pebble, and/or organic materials are more desirable than those comprised mostly of silt and clay.

Bank Stability - Bank stability is rated by observing existing or potential detachment of soil from the upper and lower banks and its potential movement into the structure. Ponds and ditches with poor banks will often have poor instream habitat.

Bank Vegetative Stability - Bank soil is generally held in place by plant root systems. An estimate of the density of bank vegetation covering the bank provides an indication of bank stability and potential instream sedimentation.

Vegetation Type - Describes the vegetation type present. Newer structure will likely have only grasses planted along banks. Older structures can have grasses, several herbaceous species, as well as shrubs and tree saplings. Wetland vegetation on newer structures may not be present, but can consist of several types of algae, submerged and emergent aquatic species at older, more established structure.

Pond/Ditch Cover - Cover vegetation is evaluated in terms of provision of shading and escape cover for fish. A rating is obtained by visually determining the dominant vegetation type covering the exposed pond bottom, bank, and top of bank. Riparian vegetation dominated by shrubs and trees provides the CPOM source in allochthonous systems.

HABITAT RESULTS

Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3)

This on-bench pond had a surface area of 0.67 acres, was 400 feet long by 125 feet wide, and had an accumulative sediment storage potential of 4.19 acre/feet (Table 4A). Due to the recent completion of this structure (1999), banks were only about 50% vegetated, and only with erosional control grasses. The substrate was sandy and silty. Because this structure has tremendous storage potential, it should serve well as a sediment control pond, but banks are steep and unstable, and need to become more established. This structure has fairly good wetland potential as it becomes more established, but only around the edges of the pond, as it will likely have open water in the center for quite some time.

Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5)

This on-bench pond had a surface area of 0.30 acres, was 200 feet long by 150 feet wide, and had an accumulative sediment storage potential of 2.70 acre/feet (Table 4A). Even though it was fairly recently completed (1997), banks were almost 100% vegetated, and with grasses and other herbaceous plants and shrubs. The substrate was sandy and gravely. This structure has good storage potential, and it should serve well as a sediment control pond. Because banks are not steep and stable, this structure will most likely remain an open water pond for quite some time. This structure has good wetland potential along the edge as it becomes more established.

Left Fork of Parker Branch (Pond Number 7)

This pond had a surface area of 1.0 acres, was 160 feet long by 240 feet wide, and had an accumulative sediment storage potential of 4.98 acre/feet (Table 4A). Because it was completed a few years ago in 1994, banks were 100% vegetated, and with grasses and other herbaceous plants, shrubs, and saplings. The substrate was silty. This structure has tremendous storage potential, and it should serve well as a sediment control pond. Because banks are not steep and stable, this structure will most likely remain an open water pond for quite some time. This structure has good wetland potential along the edges, and due to its larger size, may serve very well for waterfowl, fish, and amphibians.

Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3)

This combination ditch had a surface area of 2.12 acres, was 2250 feet long by 41 feet wide, and had an accumulative sediment storage potential of 4.28 acre/feet (Table 4B). Although it had a recent completion date (1999), banks were moderately vegetated, but only with erosional control grasses. The substrate was silty, clay. Because this structure has tremendous storage potential, it should serve well as a combination ditch. This structure has fairly good wetland potential as it becomes more established, especially due to its longer, narrower size. Because of its size, it should do very well as a water filtration structure.

Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3)

This sediment ditch had a surface area of 0.83 acres, was 900 feet long by 40 feet wide, and had an accumulative sediment storage potential of 1.67 acre/feet (Table 4B). Although it also had a recent completion date (1997), banks were well vegetated, but only with grasses, herbaceous plants, and a few shrubs. The substrate was vegetated silt. Although this structure has a low sediment storage potential, it has a tremendous wetland potential, as it is shallow and long. Because of its length and depth, it should do very well as a water filtration structure.

Left Fork of Parker Branch (Sediment Ditch Number 6)

This sediment ditch had a surface area of 0.55 acres, was 600 feet long by 40 feet wide, and had an accumulative sediment storage potential of at least 2.5 acre/feet (Table 4B). Because of its older completion date (1994), banks were very well vegetated, but only with grasses, herbaceous plants, and a few shrubs. The substrate was vegetated silty clay. This structure has a higher sediment storage potential, and should perform well as a sediment control device. It also has good wetland and open water habitat potential.

DESCRIPTION OF BENTHIC MACROINVERTEBRATE METRICS

Several benthic macroinvertebrate measurements were calculated (Tables 3A and 3B) for each of the pond and sediment ditch sites sampled. The individual metrics are described below.

Metric 1. Taxa Richness - Reflects the health of the community through a measurement of the variety of taxa present. Generally increases with increasing water quality, habitat diversity, and habitat suitability. However, the majority should be distributed in the pollution sensitive groups, a lesser amount in the facultative groups, and the least amount in the tolerant groups. Polluted streams shift to tolerant dominated communities.

Metric 2. Modified Hilsenhoff Biotic Index - This index was developed by Hilsenhoff (1987) to summarize overall pollution tolerance of the benthic arthropod community with a single value. Calculated by summarizing the number in a given taxa multiplied by its tolerance value, then divided by the total number of organisms in the sample.

Metric 3. Ratio of Scraper and Filtering Collector Functional Feeding Groups - This ratio reflects the riffle/run community foodbase and provides insight into the nature of potential disturbance factors. The relative abundance of scrapers and filtering collectors indicate the periphyton community composition, availability of suspended Fine Particulate Organic Material (FPOM) and availability of attachment sites for filtering. Filtering collectors are sensitive to toxicants bound to fine particles and should be the first group to decrease when exposed to steady sources of bound toxicants.

Metric 4. Ratio of Ephemeroptera, Plecoptera, Trichoptera (EPT) and Chironomidae Abundances - This metric uses relative abundance of these indicator groups as a measure of community balance. Good biotic condition is reflected in communities having a fairly even distribution among all four major groups and with substantial representation in the sensitive groups Ephemeroptera, Plecoptera, and Trichoptera. Skewed populations with large amounts of Chironomidae in relation to the EPT indicates environmental stress.

Metric 5. Percent Contribution of Dominant Family - This is also a measure of community balance. A community dominated by relatively few species would indicate environmental stress. A healthy community is dominated by pollution sensitive representation in the Ephemeroptera, Plecoptera, and Trichoptera groups.

Metric 6. EPT Index - This index is the total number of distinct taxa within the Orders: Ephemeroptera, Plecoptera, and Trichoptera. The EPT Index generally increases with increasing water quality. The EPT index summarizes the taxa richness within the pollution sensitive insect orders.

Metric 7. Ratio of Shredder Functional Feeding Group and Total Number of Individuals Collected - Allows evaluation of potential impairment as indicated by the shredder community. Shredders are good indicators of riparian zone impacts.

Metric 8. Simpson's Diversity Index - This index ranges from 0 (low diversity) to almost 1 (high diversity). A healthy benthic macroinvertebrate community should have a higher Simpson's Diversity Index.

Metric 9. Shannon-Wiener Diversity Index - Measures the amount of order in the community by using the number of species and the number of individuals in each species. The value increases with the number of species in the community. A healthy benthic macroinvertebrate community should have a higher Shannon-Wiener Diversity Index.

Metric 10. Shannon-Wiener Evenness - Measures the evenness, or equitability of the community by scaling one of the heterogeneity measures relative to its maximal value when each species in the sample is represented by the same number of individuals. Ranges from 0 (low equitability) to 1 (high equitability).

BENTHIC MACROINVERTEBRATE RESULTS

Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3)

A total of 1,144 individuals comprising 8 taxa were collected (Tables 2A and 5). No pollution sensitive (intolerant) taxa were present in this pond. Only one facultative (intermediate tolerance) taxa was present (the springtail Collembola) which comprised 0.3% of the sample. Seven tolerant taxa were present comprising 99.7% of the abundance at this site. The tolerant Dipteran, Chironomidae accounted for 88.5% of the total abundance, and was the most abundant taxa present at this pond on Vance Branch. No EPT groups (mayflies, stoneflies, and caddisflies) were present. No scrapers or collector/filterers were present (Table 3A). The Simpson's and Shannon-Wiener Diversity indices reflected a poorly diversified community; the Shannon-Wiener Evenness value of 0.25 indicated that abundances were poorly distributed among the taxa, or homogeneous. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a heavily pollution tolerant macroinvertebrate community with a relatively poor periphyton community composition.

Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5)

A total of 2,800 individuals comprising 12 taxa were collected (Tables 2A and 6). No pollution sensitive (intolerant) taxa were present in this on-bench pond. Five facultative (intermediate tolerance) taxa were present comprising 22.7% of the sample. The facultative mayfly Caenis (Family: Caenidae) accounted for 16.4% of the site's abundance, and was a significant component to the site's community. Seven tolerant taxa were present comprising 77.3% of the abundance at this site. The tolerant Dipteran, the midge, Chironomidae accounted for 69.1% of the total abundance, and was the most abundant taxa at this sediment pond on Rollem Fork. Four EPT groups (Table 3A) were present which contributed to the EPT:Chironomidae Index in being fairly desirable. No scrapers or collector/filterers were present. A moderate variety of mayflies and caddisflies were collected at this station. The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-low in diversity, and the Shannon-Wiener Evenness indicated that abundances were only moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a pollution tolerant/facultative, but fairly healthy benthic macroinvertebrate community.

Left Fork of Parker Branch (Pond Number 7)

A total of 4,936 individuals comprising 14 taxa were collected (Tables 2A and 7). No pollution sensitive (intolerant) taxa were present in this pond. Three facultative (intermediate tolerance) taxa were present comprising 20.4% of the sample. The facultative mayfly Caenis (Family: Caenidae) accounted for 13.6% of the site's abundance, and was a significant component to the site's community. Eleven tolerant taxa were present comprising 79.6% of the abundance at this site. The tolerant aquatic worm, Oligochaeta, accounted for 38.2% of the total abundance, and was the most abundant taxa at this sediment pond on the Left Fork of

Parker Branch. Three EPT groups (Table 3A) were present which contributed to the EPT:Chironomidae Index in being very desirable. Again, no scrapers or collector/filterers were present, however, a moderate variety of mayflies and caddisflies were collected at this station. The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-high in diversity, and the Shannon-Wiener Evenness indicated that abundances were well distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a pollution tolerant/facultative, but fairly healthy benthic macroinvertebrate community.

Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3)

A total of 464 individuals comprising 8 taxa were collected (Tables 2B and 8). No pollution sensitive (intolerant) taxa were present in this combination ditch. Two facultative (intermediate tolerance) taxa were present which comprised 1.7% of the sample. The facultative mayfly Baetis (Family: Baetidae) and the springtail, Collembola, each accounted for 0.85% of the site's abundance. Six tolerant taxa were present comprising 98.3% of the abundance at this site. The tolerant Dipteran, Chironomidae accounted for 73.3% of the total abundance, and was the most abundant taxa present at this combination ditch on Vance Branch. Only one EPT group (mayflies, stoneflies, and caddisflies) was present. No scrapers or collector/filterers were present (Table 3B). The Simpson's and Shannon-Wiener Diversity indices reflected a poorly diversified community; the Shannon-Wiener Evenness value of 0.46 indicated that abundances were also relatively poorly distributed among the taxa, or homogeneous. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a very heavily pollution tolerant macroinvertebrate community with a relatively poor periphyton community composition.

Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3)

A total of 2,576 individuals comprising 4 taxa were collected (Tables 2B and 9). No pollution sensitive (intolerant) taxa were present in this sediment ditch. No facultative (intermediate tolerance) taxa were present either. Four tolerant taxa were present comprising 100.0% of the abundance at this site. The tolerant aquatic worm, Oligochaeta, accounted for 42.2% of the total abundance, and was the most abundant taxa at this sediment ditch on Rollem Fork. No EPT groups (mayflies, stoneflies, or caddisflies) (Table 3B) were present, and no scrapers or collector/filterers were present. The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-low in diversity, and the Shannon-Wiener Evenness indicated that abundances were only moderately distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a very pollution tolerant benthic macroinvertebrate community.

Left Fork of Parker Branch (Sediment Ditch Number 6)

A total of 1,120 individuals comprising 12 taxa were collected (Tables 2B and 10). No pollution sensitive (intolerant) taxa were present in this sediment ditch. Four facultative (intermediate tolerance) taxa were present comprising 11.4% of the sample. The facultative mayfly Caenis (Family: Caenidae) accounted for 9.3% of the site's abundance, and was a significant component to the site's community. Eight tolerant taxa were present comprising 88.6% of the abundance at this site. The tolerant midge, Chironomidae, accounted for 42.9% of the total abundance, and was the most abundant taxa at this sediment ditch on the Left Fork of Parker Branch. Three EPT groups (Table 3B) were present which contributed to the EPT:Chironomidae Index in being fairly desirable. Again, no scrapers or collector/filterers were present, however, a moderate variety of mayflies and caddisflies were collected at this station. The Simpson's and Shannon-Wiener Diversity indices reflected a community moderately-high in diversity, and the Shannon-Wiener Evenness indicated that abundances were moderately-well distributed among the taxa. The Modified Hilsenhoff Biotic Index (HBI) and the relative percentages of the three tolerance groups (sensitive, facultative, and tolerant) indicated a pollution tolerant/facultative, but fairly healthy benthic macroinvertebrate community.

DISCUSSION

When comparing total abundances and taxa (Table 2A) between the three sediment control ponds sampled on October 08, 1999, it is obvious that large differences exist. The pond on Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3) contained relatively low abundances and low taxa diversity compared to the other ponds sampled, but this pond was only recently completed and therefore had not yet established an aquatic community (both vegetation and insects). Furthermore, this pond had a limiting pH level as well as limiting acidity, aluminum, and iron levels (Table 1A). The pond on Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5) had large total abundances of aquatic insects as well as a desirable number of taxa present even though this was also a relatively new pond (completion date 1997). This was most likely due to the more desirable pH level, and lower acidity, aluminum, and iron levels. The pond on the Left Fork of Parker Branch (Pond Number 7) contained the largest total abundance of aquatic insects as well as the largest number of taxa collected. This was largely due to the older age of the structure (completed in 1991), and due to the lower levels of most metals, even though pH was considered somewhat limiting.

When comparing total abundances and taxa (Table 2B) between the three sediment control ditches sampled on October 08, 1999, it is also obvious that large differences exist. The sediment ditch on Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3) contained low abundances, but moderate taxa diversity. Of the water chemistry parameters tested, only sulfates appeared to be high, thus the recent completion date of this combination ditch and hence the lack of adequate vegetation growth may have been limiting factors. The sediment ditch sampled on Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3) contained the highest total abundances, but lowest taxa diversity of all the sediment ditches sampled. The relatively recent completion date (1997) and the low pH level (Table 1B) were possible limiting factors. The sediment ditch sampled on the Left Fork of Parker Branch (Sediment Ditch Number 6) contained a moderate abundance of aquatic insects, and contained the largest number of taxa. This was somewhat a surprise since the pH level (9.39) was considered limiting.

In general, most of the ponds and sediment control ditches sampled were well represented by the groups of aquatic insects which are normally present in these lentic type habitats. The functional feeding groups scrapers and collector/filterers were never present, but this was not surprising since scrapers need silt-free environments for them to feed on the periphyton that attaches to rock substrates, and since the collector/filterers require faster-moving water in order to feed on the small particles of food which collected on constructed silken nets or on hairs on their bodies. The shredder functional feeding group (those that shred and consume leaves and other detrital materials) was also not well represented, but this group is also considered to be sensitive to disturbances and pollution. Generally, the sites were comprised mostly of tolerant organisms such as midges, dragonflies, and aquatic worms. As stated previously, this was to be expected, and was representative of aquatic insects which thrive in pond-type habitats.

Primarily, there are two reasons for the differences in aquatic insect abundances and taxa diversity between the different sediment ponds and sediment ditches: the age of the structure and water chemistry. The age of the structure is an important factor for several reasons. First, the age determines the overall composition of sediments entering the structure. Newly constructed ponds and sediment ditches are far more likely to receive very large inputs of fill materials and materials employed during the many cutting, grading, and logging activities that occur during the construction processes. Since banks and surrounding areas are barren until erosional-control grasses can be established, precipitation events can add large inputs into the new structure and cause erosional water marks. Older structures, with their established soils and heavier surrounding vegetation can "soak up" or slow much of the rainfall which would have undoubtably scarred newer structures. Second, older structures usually can have surrounding vegetation in the forms of large herbaceous plants, shrubs, and if old enough, saplings and larger trees. These larger plant forms add the detrital materials (leaves and sticks) which are a major source of food input for the aquatic insects inhabiting the sediment control pond or ditch. Thus, older, more established ponds will generally have more insects which feed directly upon the detrital materials which enter the system. These detrital materials are also a key source of the sediments which are necessary for many of the emergent and submerged aquatic plants which will eventually be desirable in the system. Newer structures must rely on food materials entering directly from the incoming streams or being flushed in from surface runoff. Newer structures with poor or unestablished benthic soils do not have the capability to produce the varieties and abundances of aquatic plants that older, more established ponds and ditches possess. Third, heavy surrounding vegetation as well as the aquatic vegetation is the "key" to a wetland's ability to facilitate water filtration. Older, more established ponds and sediment ditches, with heavy vegetation in and around the structure, are excellent at filtering solids and contaminants from the water. This is important if a goal of the structure was to remove solids and other contaminants by filtration or precipitation prior to them entering waterways farther downstream. Newer structures do not have nearly as much filtration capability as older, more vegetated ones. Fourth, the closer surrounding vegetation of the older structures provides shading to the pond's or sediment ditch's shoreline areas, thus providing hiding places for fish (if present), cooler temperatures, and places for terrestrial insects to thrive. Older structures are generally warmer along shoreline areas, and have less areas for terrestrial insects to concentrate. An important note to remember is that when most aquatic insects emerge from their aquatic stage to become an adult, they generally live near the water, and many utilize the surrounding vegetation as places to emerge, mate, and lay eggs.

As stated earlier, water chemistry is also on of the reasons for the differences in aquatic insect abundances and taxa diversity between the different sediment ponds and sediment ditches. Water chemistry is critical because it is directly responsible for two components: the aquatic insects living in the pond or sediment ditch, and the vegetation living both in and around the structure. In essence, poor water chemistry can limit, or completely exclude, the abundances and number of taxa inhabiting the aquatic resource regardless of the structure's physical habitat. Good water chemistry can provide for at least some aquatic insect communities even in the most silted environments containing hardly any food inputs. However, aquatic insects require plants, both living and dead. They utilize the dead plants (leaves, sticks) as food sources, refuge places, and even home structures. They directly use the plants living in the pond also as food sources, refuge places, and home structures, but also use them indirectly as water purifiers and as a major source of their oxygen. Normally, ponds and sediment ditches with a very good establishment of aquatic, semi-aquatic, and terrestrial vegetation will have desirable aquatic insect populations and better water quality compared to a similar, or newer, system without established vegetation. It is critical to remember that none of the aquatic, semi-aquatic, or larger terrestrial vegetation was seeded by the mining company. Waterfowl traveling from pond to pond, ingesting the seeds from the wetland vegetation, then depositing the passed seeds at different pond locations has eventually established the vegetation present at each location. Only the perennial rye, orchard grasses, and clover are used by the mining company for erosional control on newly constructed, or disturbed sites.

These sediment ponds and sediment ditches have added an additional facet to the available habitat that is currently present on mine permitted lands. Regarding the sediment ditches and channels, the Pen Coal Corporation has currently constructed over 6 miles of additional sediment channels. Most of these constructed channels were not stream channels prior to their construction. This relates to over 6 miles of additional aquatic habitat (both stream channel and wetland) which was previously non-existent prior to their construction. With regards to the "on-bench" ponds, it is very important to remember that no aquatic habitat was present in the immediate area prior to their construction. Because they were not constructed from damming an existing mountain stream, but rather from digging a hole and building up the area around the pit, no stream channels were sacrificed. They are supported entirely from surface runoff and subsurface seepage, and not from intermittent or perennial streams. Without on-bench pond and the sediment ponds located at the bottom of hollows, there would be no "natural" ponds available in the area. As an example, on land owned or leased by the Pen Coal Corporation, there are currently over 20 on-bench ponds. With each of these averaging about ½ acre in size, Pen Coal has provided over 10 acres of pond and wetland habitat with just their on-bench ponds. This does not include ponds located at the bottoms of hollows, where some stream length was sacrificed for pond/wetland acreage. This 10 acres is entirely additional pond and subsequent wetland habitat that was not available prior to their construction. These lower ponds, on-bench ponds, and sediment ditches are readily used by aquatic insects, waterfowl, amphibians, reptiles, turkeys and other wildlife creatures. An advantage to the animals which utilize the on-bench ponds, is that they do not have to travel to the bottoms of the hollows for water; they now have water sources closer to the ridgetops with the on-bench ponds. It should also be pointed out that this study was conducted during a serious drought year, and that many small streams were dry, but each of the on-bench ponds and lower elevation ponds still contained a more than adequate supply of water.

It seems ill-conceived that all sediment ditches and sediment control ponds have to be removed in order for coal companies to have fulfilled their obligation to "return the stream to its original state". Return of a stream to its original condition may never be achieved as dramatic changes to the geomorphology of the area most likely have occurred during active mining practices. Even if surrounding areas become heavily vegetated or even wooded, the fill materials exposed can alter water chemistry for many years after mining has ceased in the area. In addition, destruction of these ponds and sediment ditches along with their established wetland areas seems to be a direct violation of the practices established by the U.S. Environmental Protection Agency as well as the U.S. Army Corps of Engineers of avoiding elimination of any wetland areas.

If constructed properly, these sediment control ponds and sediment ditches can do a splendid job in removing solids and other water contaminants both by filtration and by precipitation prior to reaching downstream areas. They also provide aquatic habitats for countless abundances of aquatic insects, amphibians, reptiles, and potentially even fish. Once mining has ceased in the immediate area, these sedimentation ponds could easily be converted into an aesthetic, attractive, and usable wildlife feature with only a few modifications. For example, trees felled into the pond would add both food and habitat for many species of aquatic insects. Additional structures could be placed in the pond to provide hiding habitat for lentic fish species such as sunfish and bass. These structures would also provide a refuge for both fish and insects, act as a breeding ground for many species of insects as well as some fish. Although prohibited from planting permanent, larger-growing vegetation such as trees around structures which are considered temporary, changes in management design could take place these structures were to be considered as a permanent, and additional habitat for the area. Tall grasses, shrubs, and willow saplings, as well as larger trees could then be planted surrounding the pond to provide both a food source from fallen leaves/sticks and shade along shoreline areas. The managed pond could also be easily utilized as a refuge by waterfowl and other lentic-water animals such as amphibians and reptiles. With very little modification, most of the ponds studied for this report could provide an additional facet to the aquatic and semi-aquatic fauna currently found in area.

CONCLUSIONS

Overall, most of the ponds and sediment control ditches sampled were well represented by the groups of aquatic insects which are normally present in these lentic type habitats. The functional feeding groups scrapers and collector/filterers were never present, but this was not surprising since scrapers need silt-free environments for them to feed on the periphyton that attaches to rock substrates, and since the collector/filterers require faster-moving water in order to feed on the small particles of food which collected on constructed silken nets or on hairs on their bodies. The shredder functional feeding group (those that shred and consume leaves and other detrital materials) was also not well represented, but this group is also considered to be sensitive to disturbances and pollution. Generally, the sites were comprised mostly of large abundances and taxa of tolerant organisms such as midges, dragonflies, and aquatic worms. As stated previously, this was to be expected, and was representative of pond-type habitats.

Generally, there are two reasons for the differences in aquatic insect abundances and taxa diversity between the different sediment ponds and sediment ditches: the age of the structure and water chemistry. The age of the structure is an important factor because it determines the overall composition of sediments entering the structure, determines the amount of detrital materials (leaves and sticks) entering the system, determine the type and abundance of aquatic vegetation growing in and around the structure, determine the abundances and types of aquatic insects which can be supported in the system, and determine the filtering potential of the system. Water chemistry is critical because it is directly responsible for two components: the aquatic insects living in the pond or sediment ditch, and the vegetation living both in and around the structure. In essence, poor water chemistry can limit, or completely exclude, the abundances and number of taxa inhabiting the aquatic resource regardless of the structure's physical habitat.

These sediment ponds and sediment ditches have added an additional facet to the available habitat that is currently present on mine permitted lands. Regarding the sediment ditches and channels, the Pen Coal Corporation has currently constructed over 6 miles of additional sediment channels. Most of these constructed channels were not stream channels prior to their construction. With regards to the "on-bench" ponds, it is very important to remember that no aquatic habitat was present in the immediate area prior to their construction. On land owned or leased by the Pen Coal Corporation, there are currently over 20 on-bench ponds. With each of these averaging about ½ acre in size, Pen Coal has provided over 10 acres of pond and wetland habitat with just their on-bench ponds. These lower ponds, on-bench ponds, and sediment ditches are readily used by aquatic insects, waterfowl, amphibians, reptiles, turkeys and other wildlife creatures.

It appears to be an ill-conceived policy that all sediment ditches and sediment control ponds have to be removed in order for coal companies to have fulfilled their obligation to "return the stream to its original state". Return of a stream to its original condition may never be achieved as dramatic changes to the geomorphology of the area have most likely occurred during active mining practices. If surrounding areas become heavily vegetated or even wooded, the fill materials exposed can alter water chemistry for many years after mining has ceased in the area. In addition, destruction of these ponds and sediment ditches along with their established wetland areas seems to be a direct violation of the practices established by the U.S. Environmental Protection Agency as well as the U.S. Army Corps of Engineers of avoiding elimination of any wetland areas.

If constructed properly, these sediment control ponds, sediment ditches, and their subsequent wetlands can do a splendid job in removing solids and other water contaminants both by filtration and by precipitation prior to reaching downstream areas. They also provide aquatic habitats for countless abundances of aquatic insects, amphibians, reptiles, and potentially even fish. Once mining has ceased in the immediate area, these sedimentation ponds could easily be converted into an aesthetic, attractive, and useful habitat feature, and provide an additional facet to the aquatic, semi-aquatic, and terrestrial wildlife currently found in area.

APPENDIX A

APPENDIX B

TABLE 1A. Physical and chemical water-quality variables of sediment control ponds at Pen Coal Corporation, 08 October 1999.

PARAMETER	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Temperature (?C)	14.00	19.42	18.96
Dissolved Oxygen (mg/l)	6.73	6.45	9.61
pH (SI units)	5.04	7.82	8.77
Conductivity (? mhos)	43	189	273
BOD (mg/l)	<2	<2	3
TDS (mg/l)	602	188	278
TSS (mg/l)	554	21	1
Fecal Coliform (#/100ml)	>800	70	1
Hardness (mg/l)	26.5	134	212
Alkalinity (mg/l)	2.5	85.4	74.4
Total Acidity (mg/l)	11.2	<1.0	<1.0
Chlorides (mg/l)	<1.0	<1.0	<1.0
Sulfates (mg/l)	22.6	61.3	139
Aluminum (mg/l)	8.29	0.544	0.053
Antimony (mg/l)	<0.001	<0.001	<0.001
Arsenic (mg/l)	0.003	0.003	<0.002
Barium (mg/l)	0.080	0.040	0.040
Beryllium (mg/l)	<0.001	<0.001	<0.001
Cadmium (mg/l)	<0.0003	<0.0003	<0.0003
Calcium (mg/l)	4.28	34.4	41.1
Chromium (mg/l)	0.008	<0.001	<0.001
Copper (mg/l)	0.013	<0.005	<0.005
Iron (mg/l)	9.79	1.05	0.037
Lead (mg/l)	0.010	<0.002	<0.002
Magnesium (mg/l)	3.85	11.8	26.5
Manganese (mg/l)	0.410	0.160	0.030
Mercury (mg/l)	<0.0002	<0.0002	<0.0002
Nickel (mg/l)	<0.030	<0.030	<0.030
Selenium (mg/l)	<0.003	<0.003	<0.003
Silver (mg/l)	<0.004	<0.004	<0.004
Sodium (mg/l)	0.836	1.16	2.09
Thallium (mg/l)	<0.001	<0.001	<0.001

Zinc (mg/l)	0.034	0.019	<0.002

TABLE 1B. Physical and chemical water-quality variables of sediment ditches at Pen Coal Corporation, 08 October 1999.

PARAMETER	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Temperature (?C)	14.38	10.05	18.36
Dissolved Oxygen (mg/l)	7.43	5.42	9.46
pH (SI units)	7.03	5.32	9.39
Conductivity (? mhos)	365	281	96
BOD (mg/l)	<2	<2	<2
TDS (mg/l)	302	288	84
TSS (mg/l)	172	16	3
Fecal Coliform (#/100ml)	>270	49	14
Hardness (mg/l)	285	182	71.0
Alkalinity (mg/l)	39.2	5.8	67.1
Total Acidity (mg/l)	<1.0	13.2	<1.0
Chlorides (mg/l)	<1.0	1.3	1.2
Sulfates (mg/l)	243	210	15.8
Aluminum (mg/l)	0.714	0.491	0.109
Antimony (mg/l)	<0.001	<0.001	<0.001
Arsenic (mg/l)	0.002	0.002	<0.002
Barium (mg/l)	0.023	0.048	0.034
Beryllium (mg/l)	<0.001	<0.001	<0.001
Cadmium (mg/l)	<0.0003	<0.0003	<0.0003
Calcium (mg/l)	71.6	43.0	17.7
Chromium (mg/l)	<0.001	<0.001	<0.001
Copper (mg/l)	<0.005	<0.005	<0.005
Iron (mg/l)	0.422	1.28	0.132
Lead (mg/l)	<0.002	<0.002	<0.002
Magnesium (mg/l)	25.8	18.2	6.50
Manganese (mg/l)	1.44	3.94	0.017
Mercury (mg/l)	<0.0002	<0.0002	<0.0002
Nickel (mg/l)	<0.030	0.036	<0.030
Selenium (mg/l)	<0.003	0.003	<0.003
Silver (mg/l)	<0.004	<0.004	<0.004
Sodium (mg/l)	1.12	1.08	0.690

Thallium (mg/l)	<0.001	<0.001	<0.001
Zinc (mg/l)	0.023	0.074	<0.002

TABLE 2A. Total abundances of benthic macroinvertebrates collected via Ponar grab samples taken from sediment control ponds at the Pen Coal Corporation, 08 October 1999.

TAXON	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)			272
Caenidae			
Caenis (F)		460	672
Ephemerellidae			
Ephemerella (F)		64	
Trichoptera (Caddisflies)			
Polycentropodidae (F)		32	
Rhyacophilidae (F)		64	64
Diptera (True Flies)			
Ceratopogonidae (T)	76	76	416
Chironomidae (T)	1012	1936	976
Coleoptera (Beetles)			
Amphizoidae (T)			64
Dytiscidae (T)	12		48
Cybister (T)			72
Laccophilus (T)	12		
Haliplidae			
Haliplus (T)			8
Hemiptera (Water Bugs)			
Corixidae (T)	4	20	
Mesoveliidae (T)			136
Odonata (Dragonflies)			
Aeshnidae			
Gynacantha (T)			64
Coenagrionidae (T)	20	72	96
Gomphidae (T)			
Dromogomphus (T)		4	
Libellulidae (T)		40	160

Insecta

TABLE 2A. Continued

TAXON	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Collembola (F)	4	16	
Oligochaeta (AquaticWorms) (T)	4	16	1888
smallmouth bass juvenile* (U)		1	
Total Individuals	1,144	2,800	4,936
Total Taxa	8	12	14
Sensitive Ind. (%)	0 (0.0)	0 (0.0)	0 (0.0)
Number of Taxa	0	0	0
Facultative Ind. (%)	4 (0.3)	636 (22.7)	1008 (20.4)
Number of Taxa	1	5	3
Tolerant Ind. (%)	1140 (99.7)	2164 (77.3)	3928 (79.6)
Number of Taxa	7	7	11

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 2B. Total abundances of benthic macroinvertebrates collected via Ponar grab samples taken from sediment ditches at the Pen Coal Corporation, 08 October 1999.

TAXON	Vance Branch (1999)	Rollem Fork (1997)	Left Fork (1994)
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	4		8
Caenidae			
Caenis (F)			104
Trichoptera (Caddisflies)			
Polycentropodidae (F)			8
Diptera (True Flies)			
Ceratopogonidae (T)	64	448	40
Chironomidae (T)	340	1024	480
Tipulidae			
Tipula (T)			16
Coleoptera (Beetles)			
Amphizoidae (T)	4		
Dytiscidae			
Cybister (T)			8
Laccophilus (T)	8		
Hydrophilidae			
Berosus (T)		16	
Hemiptera (Water Bugs)			
Mesoveliidae (T)			24
Odonata (Dragonflies)			
Coenagrionidae (T)			80
Libellulidae (T)	32		104
Collembola (F)	4		8
Oligochaeta (Aquatic Worms) (T)	8	1088	240
Total Individuals	464	2,576	1,120
Total Taxa	8	4	12

TABLE 2B. Continued

	Vance Branch (1999)	Rollem Fork (1997)	Left Fork (1994)
Sensitive Ind. (%)	0 (0.0)	0 (0.0)	0 (0.0)
Number of Taxa	0	0	0
Facultative Ind. (%)	8 (1.7)	0 (0.0)	128 (11.4)
Number of Taxa	2	0	4
Tolerant Ind. (%)	456 (98.3)	2576 (100.0)	992 (88.6)
Number of Taxa	6	4	8

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 3A. Selected benthic macroinvertebrate metrics for sediment control ponds located at the Pen Coal Corporation, 08 October 1999.

METRIC	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Taxa Richness	8	12	14
Modified Hilsenhoff Biotic Index	6.05	6.03	6.06
Ratio of Scrapers to Collector/Filterers	0:0	0:0	0:0
Ratio of EPT:Chironomidae	0:1012	620:1936	1008:976
% Contribution of Dominant Family	88.5% Chiro.[1]	69.1% Chiro.[1]	38.2% Olig.[2]
EPT Index	0	4	3
% Shredders to Total	0.3%	0.6%	0.0%
Simpson's Diversity Index	0.21	0.49	0.78
Shannon-Wiener Diversity	0.74	1.63	2.74
Shannon-Wiener Evenness	0.25	0.46	0.72

1 = Diptera: Chironomidae
2 = Oligochaeta

TABLE 3B. Selected benthic macroinvertebrate metrics for sediment ditches located at the Pen Coal Corporation, 08 October 1999.

METRIC	Vance Branch (1999)	Rollem Fork (1997)	Left Fork (1994)
Taxa Richness	8	4	12
Modified Hilsenhoff Biotic Index	6.19	6.00	6.53
Ratio of Scrapers to Collector/Filterers	0:0	0:0	0:0
Ratio of EPT:Chironomidae	4:340	0:1024	120:480
% Contribution of Dominant Family	73.3% Chiro.[1]	42.2% Olig.[2]	42.9% Chiro.[1]
EPT Index	1	0	3
% Shredders to Total	0.9%	0.0%	0.7%
Simpson's Diversity Index	0.44	0.63	0.75
Shannon-Wiener Diversity	1.37	1.54	2.49
Shannon-Wiener Evenness	0.46	0.77	0.69

1 = Diptera: Chironomidae
2 = Oligochaeta

TABLE 4A. Summary of habitat descriptions for the sediment control ponds located at the Pen Coal Corporation, 08 October 1999.

	Vance Branch (1999)	Rollem Fork (1997)	Left Fork Parker (1991)
Pond/Ditch Surface Acreage	0.67	0.30	1.0
Length x Width (feet)	400 x 125	200 x 150	160 x 240
Accumulative Sediment Storage (Acre/feet)	4.19	2.70	4.98
Bottom Substrate Type	sand, silt	sandy, gravel	silty
Bank Stability	very steep, unstable	stable	stable
Bank Vegetation Stability	?50% vegetated	100% vegetated	100% vegetated
Vegetation Types	grasses (terrestrial)	grasses, shrubs, herbaceous plants, filamentous algae	grasses, shrubs, herbaceous plants, filamentous algae, emergent aquatics
Pond/Ditch Cover	none	very little	very little

TABLE 4B. Habitat descriptions for the sediment control ditches located at the Pen Coal Corporation, 08 October 1999.

	Vance Branch (1999)	Rollem Fork (1997)	Left Fork (1994)
Pond/Ditch Surface Acreage	2.12	0.83	0.55
Length x Width (feet)	2,250 x 41	900 x 40	600 x 40
Accumulative Sediment Storage (Acre/feet)	4.28	1.67	>2.58
Bottom Substrate Type	silty, clay	vegetated silt	clay, silty
Bank Stability	moderately stable	stable	stable
Bank Vegetation Stability	moderately vegetated (soils not fully developed)	100% vegetated	100% vegetated
Vegetation Types	grasses (terrestrial), some aquatic vegetation	grasses, shrubs, herbaceous plants, filamentous algae, submerged & emergent aquatics	grasses, shrubs, herbaceous plants, filamentous algae, submerged & emergent aquatics
Pond/Ditch Cover	open	some	open

TABLE 5. Abundances of benthic macroinvertebrates collected per sample from Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Diptera (True Flies)			
Ceratopogonidae (T)	8	32	36
Chironomidae (T)	148	648	216
Coleoptera (Beetles)			
Dytiscidae (T)		12	
Laccophilus (T)			12
Hemiptera (Water Bugs)			
Corixidae (T)	4		
Odonata (Dragonflies)			
Coenagrionidae (T)	4	12	4
Collembola (Springtails) (F)	4		
Oligochaeta (Aquatic Worms) (T)	4		
Total Individuals	172	704	268
Taxa	6	4	4

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 6. Abundances of benthic macroinvertebrates collected per sample from Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Caenidae			
Caenis (F)	288	112	60
Ephemerellidae			
Ephemerella (F)	64		
Trichoptera (Caddisflies)			
Polycentropodidae (F)	32		
Rhyacophilidae (F)	64		
Diptera (True Flies)			
Ceratopogonidae (T)	64		12
Chironomidae (T)	1088	272	576
Hemiptera (Water Bugs)			
Corixidae (T)		16	4
Odonata (Dragonflies)			
Coenagrionidae (T)	64		8
Gomphidae			
Dromogomphus (T)			4
Libellulidae (T)	32		8
Collembola (Springtails) (F)		16	
Oligochaeta (Aquatic Worms) (T)		16	
smallmouth bass juvenile* (U)			1
Total Individuals	1696	432	672
Taxa	8	5	7

* = Not included in abundance or taxa calculations. For observation only.

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 7. Abundances of benthic macroinvertebrates collected per sample from Left Fork of Parker Branch (Pond Number 7), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	80	128	64
Caenidae			
Caenis (F)	224	256	192
Trichoptera (Caddisflies)			
Rhyacophilidae (F)		64	
Diptera (True Flies)			
Ceratopogonidae (T)	80	256	80
Chironomidae (T)	240	512	224
Coleoptera (Beetles)			
Amphizoidae (T)		64	
Dytiscidae (T)	16		32
Cybister (T)	8	64	
Haliplidae			
Haliplus (T)	8		
Hemiptera (Water Bugs)			
Mesoveliidae (T)	8	128	
Odonata (Dragonflies)			
Aeshnidae			
Gynacantha (T)		64	
Coenagrionidae (T)	16	64	16
Libellulidae (T)	32	128	
Oligochaeta (Aquatic Worms) (T)	544	832	512
Total Individuals	1256	2560	1120
Taxa	11	12	7

( ) Classification of Pollution Indicator Organisms
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TABLE 8. Abundances of benthic macroinvertebrates collected per sample from Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)			4
Diptera (True Flies)			
Ceratopogonidae (T)	12	52	
Chironomidae (T)	56	156	128
Coleoptera (Beetles)			
Amphizoidae (T)		4	
Dytiscidae (T)			
Laccophilus (T)			8
Odonata (Dragonflies)			
Libellulidae (T)	24	4	4
Collembola (Springtails) (F)	4		
Oligochaeta (Aquatic Worms) (T)		4	4
Total Individuals	96	220	148
Taxa	4	5	5

( ) Classification of Pollution Indicator Organisms
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TABLE 9. Abundances of benthic macroinvertebrates collected per sample from Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3), 08 October 1999.

	SAMPLE		
TAXON	Ponar 1	Ponar 2	Ponar 3
Insecta			
Diptera (True Flies)			
Ceratopogonidae (T)	48	384	16
Chironomidae (T)	256	576	192
Coleoptera (Beetles)			
Hydrophilidae			
Berosus (T)	16		
Oligochaeta (Aquatic Worms) (T)	384	576	128
Total Individuals	704	1536	336
Taxa	4	3	3

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

TABLE 10. Abundances of benthic macroinvertebrates collected per sample from Left Fork of Parker Branch (Sediment Ditch Number 6), 08 October 1999.

TAXON	SAMPLE Ponar 1	Ponar 2	Ponar 3
Insecta			
Ephemeroptera (Mayflies)			
Baetidae			
Baetis (F)	8		
Caenidae			
Caenis (F)	24	64	16
Trichoptera (Caddisflies)			
Polycentropodidae (F)			8
Diptera (True Flies)			
Ceratopogonidae (T)	16	16	8
Chironomidae (T)	112	160	208
Tipulidae			
Tipula (T)		16	
Coleoptera (Beetles)			
Dytiscidae (T)			8
Cybister (T)			
Hemiptera (Water Bugs)			
Mesoveliidae (T)	8	16	
Odonata (Dragonflies)			
Coenagrionidae (T)		64	16
Libellulidae (T)		64	40
Collembola (Springtails) (F)			8
Oligochaeta (Aquatic Worms) (T)	48	16	176
Total Individuals	216	416	488
Taxa	6	8	9

( ) Classification of Pollution Indicator Organisms
(S) = Sensitive (F) = Facultative (T) = Tolerant (U) = Unclassified

APPENDIX C

Photograph 1. Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3).

Photograph 2. Vance Branch (Rollem Fork Number 3 Surface Mine; On-Bench Pond Number BP3).

Photograph 3. Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5).

Photograph 4. Rollem Fork (Rollem Fork Number 2 Surface Mine; On-Bench Pond Number 5).

Photograph 5. Left Fork of Parker Branch (Pond Number 7).

Photograph 6. Left Fork of Parker Branch (Pond Number 7).

Photograph 7. Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3).

Photograph 8. Vance Branch (Rollem Fork Number 3 Surface Mine; Combination Ditch Number CD3).

Photograph 9. Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3)

Photograph 10. Rollem Fork (Rollem Fork Number 2 Surface Mine; Sediment Ditch Number SD-3)

Photograph 11. Left Fork of Parker Branch (Sediment Ditch Number 6).

Photograph 12. Left Fork of Parker Branch (Sediment Ditch Number 6).