PIEDMONT ECOREGION

Codorus Creek Watershed

Codorus Creek Watershed includes part of Hanover, Pa., and most of York, Pa. This survey included four mainstem samples and two samples taken on South Branch Codorus Creek. All the sites had "middle" water quality except for the site at the mouth, which exceeded levels of concern for six parameters (Table 4). This site was located in a picturesque glen along the Susquehanna River; however, the biology was slightly impaired, and a distinct wastewater odor was present. The habitat at this site was rated excellent, since it was located in the forested river hills. Upstream portions of the creek were completely channelized and degraded in the urban York area. Nutrient concentrations were high at the other mainstem sites, and CODO 22.4 was the only site with nonimpaired biology compared to other sites in its reference category (64d). No stoneflies were present, but a number of pollution-tolerant mayflies were present.

The two headwater sites, CODO 34.1 and CODO 33.0, were sampled upstream and downstream of the West Branch Codorus Creek, which includes Codorus Creek State Park and Lake Marburg. The West Branch Codorus Creek and the lake influenced biological conditions (such as a change in mayfly taxa, a decrease in Chironomidae, and the presence of amphipods) at the downstream site. Also, the levels of nitrate-n and total nitrogen were diluted by flow from the West Branch Codorus Creek. South Branch Codorus Creek had nonimpaired biological conditions, although the water quality was rated "middle" due to elevated nutrients, and the habitat was supporting. SBCD 3.6 was located downstream of a pasture where cows had access to the stream. Also, the headwaters of South Branch Codorus Creek are impacted by new development and associated municipal discharges, which could be a source of elevated nutrients.

Chiques Creek Watershed

Chiques Creek flows through the agricultural communities surrounding Mount Joy, Landisville, and Manheim, Pa. The headwaters of Chiques Creek originate in a forested state game lands area; however, forested areas make up a very small portion of the land use of the watershed, which was dominated highly by agriculture. The biological condition at the headwater site, CHIQ 20.0, was rated slightly impaired. The water quality was rated "middle" due to elevated nutrients, and the habitat was rated supporting. Little Chiques Creek was severely polluted by nutrients and had a "lower" water quality rating. This site had the highest levels of nitrate-n (11.2 mg/l) and total nitrogen (11.37 mg/l) in addition to elevated levels of orthophosphate, total phosphorus, sodium, and total suspended solids (Table 4). The macroinvertebrate population was moderately impaired and was dominated by amphipods, which is indicative of a limestone stream. There were few mayflies and no stoneflies in the sample. CHIQ 3.0, which was downstream of Little Chiques Creek, appeared to be influenced by the water quality of Little Chiques Creek. The nitrate-n and total nitrogen were both 11.0 mg/l, and orthophosphate and sodium levels were high also (Table 4). CHIQ 3.0 was downstream of the site sampled in 1996 due to lack of suitable sampling habitat.

Also, the headwaters of South Branch Codorus Creek are impacted by new development and associated municipal discharges, which could be a source of elevated nutrients.

Kreutz Creek Watershed

Kreutz Creek, located on the western side of the Susquehanna River, flowed through small towns, suburbs of York, state and county parks, and agricultural areas. The biological condition of the site sampled was nonimpaired, although the water chemistry indicated elevated nitrate-n, nitrite-n, and total nitrogen levels. The habitat was influenced by a golf course upstream and was rated supporting.

Conestoga River Watershed

The biological conditions at most of the sites in the Conestoga River Watershed were rated slightly impaired, except MIDD 0.2, MUDD 0.2, and CNTG 43.9, which were rated nonimpaired. Additionally, the upper site on Cocalico Creek (CCLC 12.2) was rated moderately impaired. Both sites on Cocalico Creek were impacted by high nutrient levels. The upper site, CCLC 12.2, had slightly higher nutrient levels and higher sodium levels than CCLC 0.4 (Table 4). All the sites in the Conestoga River Watershed had high levels of nutrients with nitrate-n and total nitrogen concentrations higher than 5.0 mg/l except at MUDD 0.2, which served as the reference site for sites in the group 64d. MILL 0.3 had the highest level of sodium (80.5 mg/l), specific conductivity (940 µmhos/cm), and total chloride (130 mg/l) of all the streams in the Lower Susquehanna Subbasin (Table 4). Orthophosphate concentrations were high on all the mainstem Conestoga River sites with levels increasing toward the mouth. Total phosphorus and sodium exceeded levels of concern at the two most downstream sites, CNTG 22.6 and CNTG 0.9. At most sites, habitat was rated supporting, with two sites rated excellent (LCNT 1.7 and HAMM 0.2) and two sites rated partially supporting (CNTG 22.6 and CCLC 0.4).

SRBC conducted a periphyton study on the Conestoga River Watershed simultaneously with the Lower Susquehanna Subbasin Survey sampling. The periphyton study was part of a nutrient TMDL study funded by the PADEP. Low flow conditions were targeted to determine how point sources in this watershed impacted the stream water chemistry and periphyton populations. Also, an assessment of the relationship between the periphyton and macroinvertebrates will be conducted and the use of each as indicators of nutrient pollution will be analyzed. The periphyton study is ongoing with sampling planned for summer 2006 and 2007.

Pequea Creek Watershed

Like most of the other watersheds in the Piedmont Region, Pequea Creek was impacted by agricultural land use. The nutrient levels were high at both mainstem and tributary sites that were sampled. Of these sites, the headwater station (PQEA 15.2) had the highest levels of total nitrate-n (8.65 mg/l), nitrogen (8.85 mg/l), orthophosphate (0.133 mg/l), and phosphorus (0.187 mg/l), and also had elevated total suspended solids (42 mg/l) (Table 4). The water quality at PQEA 15.2 was rated "lower," while the other mainstem site (PQEA 3.3) and the tributary site (SBEV 2.5) were rated "middle" quality. The biological conditions at all three sites were rated slightly impaired. Habitat ranged from partially supporting to excellent. The habitat at PQEA 15.2 was rated low due to excessive bank erosion and siltation. SBEV 2.5 habitat had potential for improvement if a stream bank fencing program would be implemented. PQEA 3.3 was located in the southern portion of Lancaster County, which is more influenced by river hills and was more forested.

Muddy Creek Watershed

Muddy Creek Watershed located in southern York County was one of the higher quality watersheds in the Lower Susquehanna Subbasin. The biological conditions at all sites (MDDY 3.3, NBMY 0.0, and SBMY 0.0) sampled in this watershed were rated nonimpaired. The two sites on North Branch Muddy Creek and South Branch Muddy Creek also had excellent habitat conditions. The site on North Branch Muddy Creek (NBMY 0.0) served as a reference site for group 64ac. As with many streams in the Piedmont Region, the water quality was rated "middle" due to elevated total nitrate-n and total nitrogen. This watershed was more forested and less urban than the other watersheds in the Piedmont Region. Figure 3 indicates that the stream channel was buffered with natural vegetated areas.

Conowingo Creek Watershed

Conowingo Creek was sampled at the Pennsylvania and Maryland state line since this was also an SRBC Interstate Streams Monitoring Program station. In 2003, this site was rated slightly impaired, and nutrient and total iron concentrations were high in some of the quarterly samples (Hoffman and Sitlinger, 2005). In 2005, as part of the Lower Susquehanna Subbasin Survey, this site had a nonimpaired biological condition, and the water quality was rated "middle" due to high levels of nutrients. High levels of iron were not noted in this sample. The different biological rating may not be an indication of improvement as much as an indication of different reference conditions and stream sites in the reference category. The habitat score was slightly lower in 2005 than in 2003.

D. Hintz

Streambank fencing with cow passageway on Muddy Creek in Lancaster County.

Octoraro Creek Watershed

The east and west branches and the main stem near the mouth were sampled in the Octoraro Creek Watershed. All sites had "middle" water quality based on elevated levels of nutrients at the time of sampling. The highest levels of nitrates and nitrogen were found in the two branches of the creek and were diluted somewhat towards the mouth, whereas the highest levels of orthophosphates and phosphorus were found at the mouth. The habitat was rated excellent at all three sites; however, the macroinvertebrate populations were rated nonimpaired on the West Branch Octoraro and at the mouth and slightly impaired on East Branch Octoraro Creek. The West Branch Octoraro Creek is a popular fishing spot and is surrounded in parts by state game lands. Octoraro Creek at a station on the Pennsylvania-Maryland state line was rated slightly impaired in SRBC's last published Interstate Streams Report (Hoffman and Sitlinger, 2005); however, it has been rated nonimpaired in the past. Iron concentrations were high at the time of sampling, but this was most likely due to erosion of soils during high flows.

Deer Creek Watershed

Most of the Deer Creek Watershed lies in Maryland in a rural agricultural and forested area with no large urban areas. The macroinvertebrate populations at the two sampling sites on Deer Creek were nonimpaired. The water quality at both was rated "middle" due to somewhat elevated total nitrate-n and total nitrogen levels. This watershed also was monitored along the Pennsylvania-Maryland state line as part of the Interstate Streams Monitoring Program. Deer Creek and its tributaries often served as reference sites for the streams along the Pennsylvania-Maryland border (Hoffman and Sitlinger, 2005).

Harford County Department of Planning and Zoning in conjunction with Maryland DNR and other stakeholders is developing a Watershed Restoration Action Strategy (WRAS) for Deer Creek. A WRAS is a watershed plan that is developed to identify areas of concern or interest and create a plan for restoration and protection. These plans resulted from the 2000 Chesapeake Bay Agreement. Prior to the development of the WRAS, preliminary work was conducted on the watershed, and documents were created on the characterization of the watershed, assessments of the stream

corridor, and synoptic surveys. These supporting documents provide a more detailed assessment of the Deer Creek Watershed and are located at *http://dnr.maryland.gov/watersheds/surf/proj/wras.html.* More information about the WRAS process is available at *http://dnr.maryland.gov/watersheds/WRAS/.*

SUSQUEHANNA RIVER MAINSTEM

The Susquehanna River Mainstem sites were analyzed separately from other Lower Susquehanna Subbasin sites due to their large drainage size and different nature. SUSQ 77.0 served as a reference site for the Susquehanna River Mainstem sites. All the sites on the mainstem Susquehanna River had fairly similar biological conditions except for SUSQ 122.0, which was rated slightly impaired. Ironically, this was the only site to receive a "higher" water quality rating. This was most likely due to dilution or a one-time sample that was not representative of usual conditions. SUSQ 122.0 was located downstream of Sunbury, Pa., which is where the West Branch Susquehanna River and the North Branch Susquehanna River join to form the main stem. The next two sites downstream, SUSQ 106.0 and SUSQ 94.0, received "lower" water quality ratings mostly due to elevated specific conductivity. This elevated conductivity may be due to the influence of the AMD-impacted streams that flow into the Susquehanna from the east. The site farther downstream, SUSQ 77.0, was downstream of the high quality streams, such as Powell, Clark, Stony, and Sherman Creeks. Slightly elevated total nitrogen and sodium were the reason for the "middle" water quality rating. SUSQ 44.5 also was rated as "middle" quality with slightly elevated total nitrogen, sodium, and temperature. This site was an Interstate Streams Monitoring site and had received nonimpaired and slightly impaired ratings throughout the past couple years, although no sample was collected in 2003 (Hoffman and Sitlinger, 2005).

COMPARISON of 1996 and 2005 DATA

A comparison of historical Lower Susquehanna Subbasin data from 1996 and the current survey data from 2005 indicated overall similarity with some slight changes in biological and water quality conditions. Biological conditions seemed to be slightly better in 2005, while water quality appeared to improve in some parameters but degrade in others. The results for water quality, biological, and habitat conditions in the 1996 Lower Susquehanna Subbasin Survey are depicted in Figure 5. Two sites, CEDR 0.1 and CHIQ 20.0, were added to the survey in 2005 and are in blue print in the Appendix, since these sites were not included in the historical data. The methods have changed slightly throughout the years, and the methods for the 1996 survey can be found in Traver (1997). Specifically, the number of macroinvertebrates subsampled changed from 100 to 200, the habitat assessment form changed to assigning each parameter 20 points instead of weighting the parameters with different point ranges, and the water quality assessment analysis has changed. In the 1997 report, Traver assessed water quality using Principal Components Analysis and cluster analysis and did not assign rating categories for site conditions. For comparison purposes, the 1996 data were analyzed using current methodology to acquire water quality site condition ratings. In addition, the reference categories have changed due to advances in Geographic Information Systems technology and calculation of drainage size. MNTN 3.0 was the only site in Ecoregion 66, so this site was grouped with 67cd.
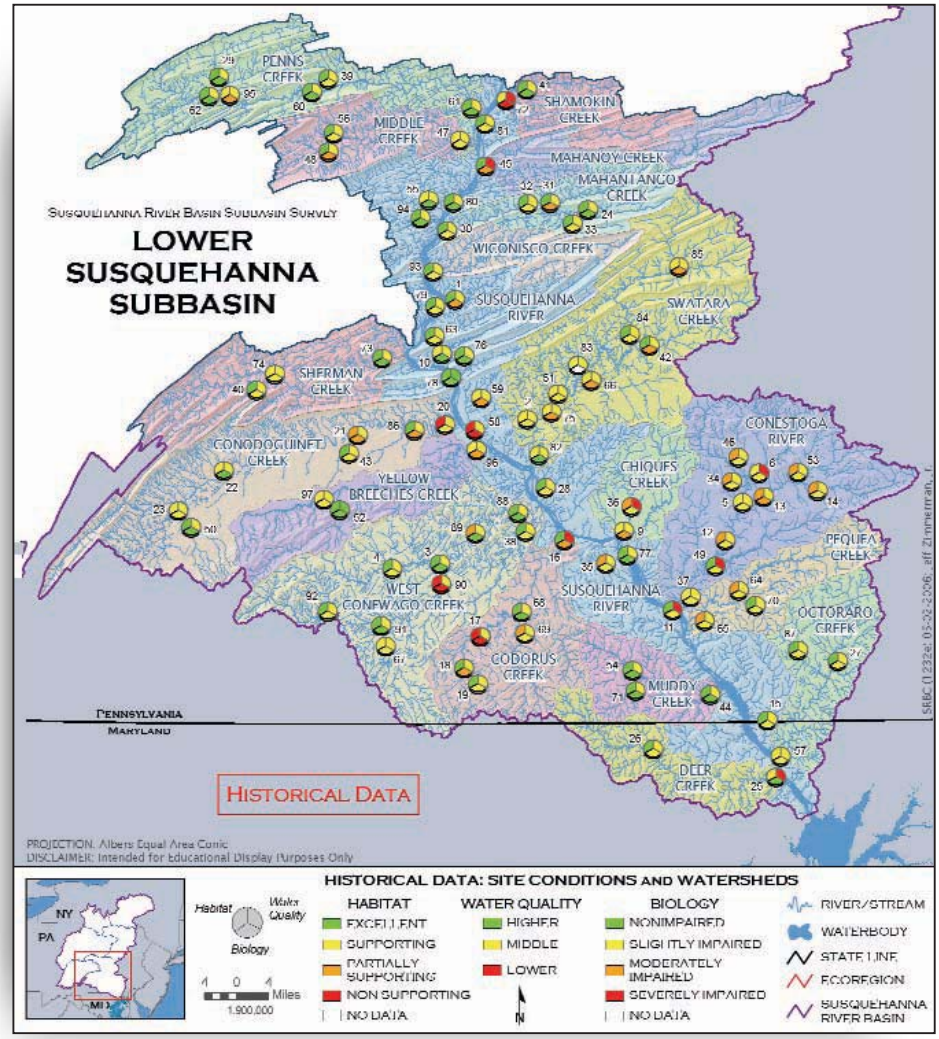
Figure 5. *Water Quality, Biological, and Habitat Conditions in 1996 Sample Sites in the Lower Susquehanna Subbasin*