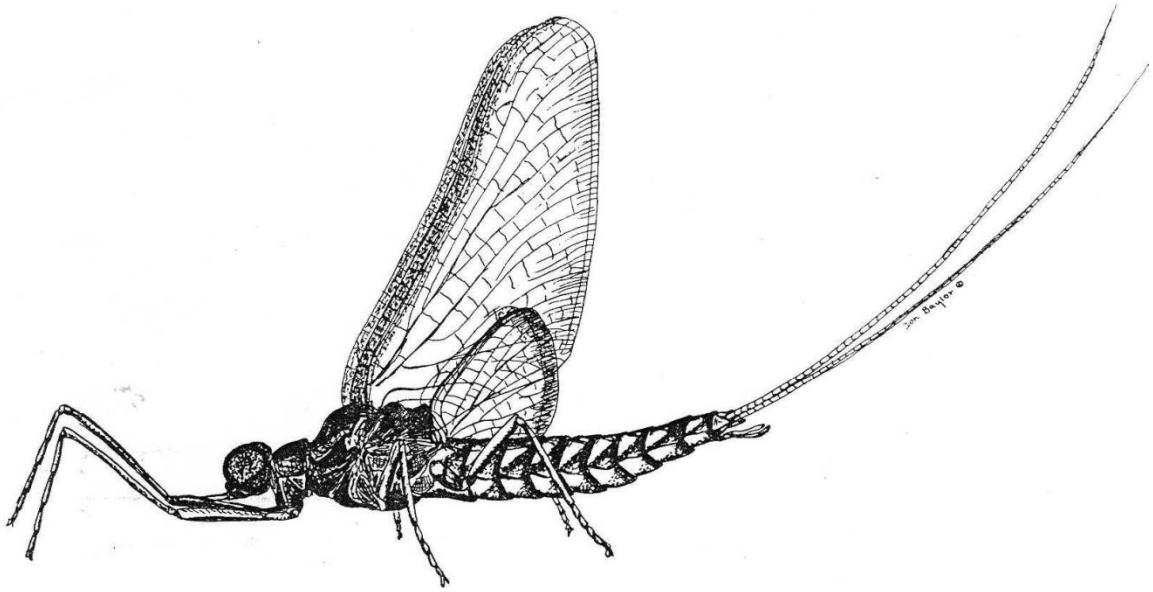
ENVIRONMENTAL QUALITY
OF
PIKE COUNTY STREAMS



DECEMBER 2021

ENVIRONMENTAL QUALITY OF PIKE COUNTY STREAMS

Prepared For

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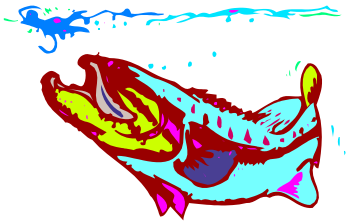

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INTRODUCTION

Biological monitoring of surface waters serves several purposes. It provides an early warning of hazardous changes in water quality, detects episodic events such as pollution spills, evaluates recovery from disturbed conditions, and reveals environmental trends and cycles.

Aquatic macroinvertebrates (primarily insects) and fish are important biological components of freshwater systems. They are the fundamental sensors of any stress that occurs within a stream ecosystem. This stress, which manifests itself in the health of aquatic organisms, can cause subtle or dramatic changes in overall community structure.

Work in bio-monitoring of stream communities has emphasized cost-effective protocols that attempt to extract maximum information with the least possible expenditure of time and money. Some of these methods have become standards in the field of bio-monitoring.

The United States Environmental Protection Agency (USEPA) provides several rapid bioassessment procedures for macroinvertebrate and fish populations (Plafkin et al, 1989). The Pennsylvania Department of Environmental Protection (PADEP) has developed its own assessment and listing methodology for integrated water quality monitoring (PADEP, 2007, 2009, 2012, 2015). Besides providing a means for monitoring temporal trends in aquatic life communities, it also provides a means for evaluating effects among stations.

Pike County has numerous freshwater streams ranging from small headwaters to large rivers. Nearly all these waterways are classified by the PADEP as “High-Quality” or “Exceptional Value” (PADEP, 1996). The aquatic life communities in these riverine ecosystems have similar characteristics that allow for regional comparisons. However, subtle but recognizable differences do occur between streams of varying size and gradient, and between those waters located above and below impoundments. Consequently, these differences must be noted and considered in any stream comparison or evaluation using the PADEP “Assessment Methodology”.

METHODS

Pike County Conservation District (PCCD) personnel sampled fish and benthic macroinvertebrates at baseline and non-point stream sites in Pike County with the assistance of Aquatic Resource Consulting biologists. These sites were established in 1995 as part of the Pike County Water Quality Program network (PCCD, 1995). Additional sites have subsequently been added. The study was to monitor water quality and determine how sites compared to designated use criteria established for Pennsylvania streams by the Pennsylvania Department of Environmental Protection (PA DEP, 2007, 2009, 2012, 2015).

Stream Habitat and Water Quality

The Pennsylvania Department of Environmental Protection (PADEP) Flowing Waterbody Field Data and Water Quality Habitat Assessment Forms were filled out for each station. Field measurements included stream temperature, dissolved oxygen, pH, alkalinity and conductivity. Land use and canopy cover at each site were also assessed. Habitat was evaluated at each station using PADEP's Water Quality Network Habitat Assessment forms for streams with a riffle/run prevalence. Twelve habitat parameters were ranked on a scale of 1-20 and combined for a total habitat score. Scores put habitat into categories of optimal, sub-optimal, marginal, and poor. According to protocols, scores that fall between these category ranges are left to the decision of the investigator for classification.

Macroinvertebrate Communities

Macroinvertebrate sampling methods followed those recommended by the US Environmental Protection Agency Protocol III (Plafkin, et al., 1989) with the latest modifications adopted by the PA Department of Environmental Protection (PADEP, 2015). At each station, six samples were taken from a riffle/run area with a dip net of 500µm nitex. Samples were taken by placing the net against the substrate and disturbing approximately one square meter above the net by foot for one minute. Organisms and debris were composited for each station in a plastic container and preserved in 90% isopropyl alcohol for transport to the laboratory. In the laboratory, organisms were removed from the debris and placed in a white pan marked with a grid to delineate 21 squares measuring two inches on a side. Organisms were then picked from randomly selected grids until 200 (±40) organisms were obtained. Organisms were identified to genera or the lowest taxonomic level practicable, enumerated, and assigned a pollution tolerance value (PADEP, 2007) – Appendix A. Metrics for riffle/run freestone streams were calculated for each sub-sample, including Modified Beck's Index (MBI), Ephemeroptera + Plecoptera + Trichoptera taxa richness (EPT), total taxa richness, Shannon diversity index (DI), Hilsenhoff biotic index (BI), percent dominant taxon, and percent intolerant individuals. A description and brief rationale for each of the metrics follow:

1. **Modified Beck's Index** is a weighted count of taxa with pollution tolerance values of 0, 1, or 2. This metric is expected to decrease in value with increasing anthropogenic

stress to a stream ecosystem, reflecting the loss of pollution sensitive taxa. It is calculated by multiplying by 3 the number of taxa with a pollution tolerance value of 0, multiplying by 2 the number of taxa with a pollution tolerance value of 1, and multiplying by 1 the number of taxa with a pollution tolerance value of 2. The three values are added to yield the Modified Beck's Index score.

2. **EPT Taxa Richness** (mayflies, stoneflies, and caddisflies), collectively referred to as EPT, are generally considered pollution sensitive (Plafkin et al. 1989). Thus, the total number of taxa within the EPT insect groups with 0-4 tolerance values are used to evaluate community balance. Healthy biotic conditions are reflected when these taxa are well represented in the benthic community.

3. **Total Taxa Richness** is an index of diversity. The number of taxa (kinds) of invertebrates indicates the health of the benthic community through measurement of the variety of species present. Generally, the number of species increases with increased water quality. However, variability in natural habitat (stream order and size, substrate composition, current velocity) also affects this number.

4. **Shannon Diversity Index** measures taxonomic richness and evenness of numbers of individuals across the taxa of a subsample. This metric is expected to decrease in value with increased anthropogenic stress to a stream ecosystem, reflecting loss of pollution-sensitive taxa and predominance of a few pollution-tolerant taxa.

5. **Hilsenhoff Biotic Index** is a direct measure of organic pollution in streams. The biotic index value is the mean tolerance value of all organisms in a sample (Table 1). Tolerance values range from 0.00 to 10.00; the higher the value, the greater the level of pollution indicated.

Table 1. Evaluation of water quality using biotic index values (Hilsenhoff, 1987)

BIOTIC INDEX	**WATER QUALITY**	**DEGREE OF ORGANIC POLLUTION**
0.00-3.50	Excellent	None Apparent
3.51-4.50	Very Good	Possible Slight
4.51-5.50	Good	Some
5.51-6.50	Fair	Fairly Significant
6.51-7.50	Fairly Poor	Significant
7.51-8.50	Poor	Very Significant
8.51-10.00	Very Poor	Severe

6. **Percent Intolerant Individuals** is the percentage of individuals in the subsample with pollution tolerance values of three or less. It is expected to decrease in value with increasing anthropogenic stress to a stream ecosystem.

Index of Biotic Integrity Calculation

An overall index is used to integrate information from these various metrics and standardize them into one score for a subsample (PADEP, 2009). The values for any standardized core metric are set to a maximum value of 1.00, with values closer to zero corresponding to increasing deviation from the expected reference condition and progressively higher values corresponding more closely to the biological reference condition. The adjusted standardized metric values for the six core metrics are averaged and multiplied by 100 to produce an index score ranging from 0-100. This number represents the index of biotic integrity (IBI) score for a sample. Table 2 shows a sample of metric standardization equations and index calculations for a large freestone stream site (>50 square miles):

Table 2. Sample metric standardization and index of biotic integrity calculations for a benthic macroinvertebrate sample for a large freestone stream.

Metric	Standardization Equation	Observed Metric Value	Standardized Metric Score	Adjusted Standardized Metric Score Maximum =100
Modified Beck's Index	Observed value/22*100	40	181.8	100
EPT Taxa Richness	Observed Value/16*100	22	137.5	100
Total Taxa Richness	Observed value/31*100	33	106.5	100
Shannon Diversity Index	Observed Value/2.90	2.67	93.4	93.4
Hilsenhoff Biotic Index	10-observed value/ (10-3.05)*100	3.47	94.0	94.0
Percent Intolerant Individuals	Observed value/66.7*100	48.8	73.2	73.2
Average of adjusted standardized core metric scores x 100 = IBI score				**93.4**

Smaller streams (<25 square miles) have different standardization values. Streams between 25 and 50 square miles may have either standardization value applied to them. Pennsylvania DEP Index of Biotic Integrity scoring benchmarks require analysis through a multi-tiered flow chart. This decision process should act only as a guide for assessment as certain situations may not apply exactly as outlined.

Fish Communities

Fish communities were sampled in September, 2021 at one baseline stream sites and four non-point sites identified by the Pike County Conservation District and Aquatic Resource Consulting (ARC) – Appendix B. Each stream site was sampled with a battery- powered, variable voltage, Smith-Root backpack electrofishing unit with 6-foot anode

probe. Direct-pulsed current at 45 Hz was used to cause electronarcosis in the fish being collected.

Effort was standardized at each site by sampling for a period of 20 minutes or until 300 linear feet of stream had been traversed. As recommended by the PADEP 2007 protocols for sampling fish, the sample reach was at least 10 times the mean width, or a minimum of 300 feet. All fish were collected on the first pass through the sampling area and stored in a live well.

All fish were identified to species and enumerated. Fish were checked for anomalies, such as discoloration, deformities, eroded fins, excessive mucous, fungus, parasites, poor condition, reddening, tumors and/or ulcers. Exotic or introduced species were noted. Following collection of data fish were returned to the stream unharmed.

Fish habitat was assessed at each station by measuring stream widths (wetted perimeter) at 50-foot intervals and estimating mean width (Appendix B). Each station was then placed in a standard stream width category for future comparison to other streams in the region. The categories were as follows: <10 ft. = 1, 10-20 ft. = 2, 21-40 ft. = 3, 41-60 ft. = 4, and >60 ft. = 5.

For this study, ten (10) biological characteristics (metrics) were used to assess the fish communities (Lyons et al., 1996 and Karr et al., 1986). They were based on the fish community's taxonomic and trophic (food guild) composition, and the abundance and thermal tolerance of fish (Table 7). These metrics attempt to quantify the quality of the fish community. Comparing values with those expected for the region scores each of these evaluations. Scoring criteria were based on historical data collected from numerous stream sites in Pike County between 1995 and 2020 by Aquatic Resource Consulting. Metric values approximating, deviating slightly from, or deviating greatly from values expected in high quality streams are scored as 5, 3, or 1, respectively. The scores for each metric are tabulated to give a sum ranging from 50 (excellent) to 10 (very poor). This score is known as the index of biotic integrity (IBI).

The IBI serves as an integrated analysis because individual components may differ in their relative sensitivity to various levels of biological condition. A description and brief rationale for each of the 10 IBI metrics used for this study is outlined below.

TABLE 3. Index of biotic integrity (IBI) metrics and the scoring criteria used for each to calculate the IBI scores for Pike County fish populations.

IBI Metrics	Scoring Criteria 5	3	1
1. Number of Intolerant Species	>2	1-2	0
2. Percent of Individuals that are Tolerant	<11%	11-35%	>35%
3. Percent of Individuals that are Top Carnivores	>19%	8-19%	<8%
4. Percent of Individuals that are Coolwater or Coldwater	>83%	43-83%	<43%
5. Percent of Salmonid Individuals that are Brook Trout	>2%	1-2%	<1%
6. Percent of Individuals that are Insectivores	>56%	44-56%	<44%
7. Percent of Individuals that are Pioneering Species	<21%	21-56%	>56%
8. Catch per 20 Minute Effort	>142	96-142	<96
9. Percent of Individuals that are Lithophilic Spawners	>89%	72-89%	<72%
10. Number of YOY Trout Caught Per 20 Minute Effort	>11	1-11	<1

1. Number of intolerant species - recognizes those fish that are sensitive to degradation resulting from siltation and oxygen depletion because they feed and reproduce in benthic (stream bottom) habitats.

2. Percent of individuals that are tolerant species - measures those fish species present that are tolerant to a variety of chemical and physical pollutants, and which tend to dominate a fish community that is degraded.

3. Percent of individuals that are top carnivore species - measures that portion of the fish community that feed on other fish. The dominant carnivores in cold water streams are pollution sensitive adult salmonids (trout).

4. Percent of individuals that are stenothermal coolwater and coldwater species - measures that portion of the fish community that is intolerant to warm water conditions. Stenothermal fish species are often associated with high water quality.

5. Percent of salmonid individuals that are brook trout - Brook trout are often associated with high-quality, cold water streams. They are pollution sensitive to chemicals, elevated water temperatures, and siltation.

6. Percent of individuals that are insectivores - measures that portion of the fish community that feed on insects. The percent of insectivores, which are the dominant trophic guild in clean waters, increases as the physical and chemical habitat improves.

7. Percent of individuals as pioneering species - measures the proportion of the fish community represented by species which dominate in fluctuating environments such as variable flow regimes, chronic shifts in stream temperature, shifting habitats, and pulses of chemical pollutants. Generally, the number of pioneering species increases as water quality declines.

8. Catch per 20 minute effort - measures the density of the fish community, which varies with region and stream size. Generally, the number of fish increases with improving stream conditions.

9. Percent lithophilic spawners - is an estimate of the suitability of the habitat for reproduction by fish species that build nests in sand, gravel and cobble substrates. These fish provide no parental care of their young after the eggs are laid and fertilized. Generally, as environmental degradation increases the number of lithophilic spawners declines.

10. Catch of young-of-year trout per 20 minute effort – measures the capacity of a stream to reproduce trout species. The number of young-of-year trout increases with improving stream conditions.

Sampling Stations

Nine baseline and nine non-point study stations were sampled for benthic macroinvertebrates in April and May, 2021 (Appendix A). One baseline and four non-point stations were sampled for fish in September, 2021 (Appendix B). Following are descriptions and co-ordinates for the macroinvertebrate and fish stations:

Macroinvertebrates

Station 01 – Saw Creek, Lehman Township; 41.089659/-75.038688

Station 02 – Big Bushkill Creek, Lehman Township; 41.090662/-75.004328

Station 03 – Little Bushkill Creek, Lehman Township; 41.092345/-75.004387

Station 05 – Hornbeck's Creek, Delaware Township; 41.195653/-74.909446

Station 06 – Dingman's Creek, Delaware Township; 41.231694/-74.910548

Station 07 – Adams Creek, Delaware Township; 41.261335/-74.890436

Station 08 – Raymondskill Creek, Dingmans Township; 41.303758/-74.854798

Station 12 – Bush Kill Creek, Westfall Township, 41.409343/-74.743587

Station 16 – Masthope Creek, Lackawaxen Township; 41.539618/-75.032834

Station 19N – Saw Creek, Lehman Township, 41.137486/-75.053638

Station 20N – Tom's Creek, Lehman Township; 41.142606/-74.962511

Station 24N – Sawkill Creek, Milford Township; 41.334251/-74.824545

Station 26N – Rosetown Creek, Matamoras Township; 41.354596/-74.72905

Station 33N – Balliard Creek, Shohola Township; 41.419379/-74.980858

Station 35N – Shohola Creek, Blooming Grove Township, 41.359891/-75.057742

Station 36N – Pond Eddy Creek, Shohola Township; 41.429517/-74.824731

Station 40N – Westfalls Creek, Lackawaxen Township; 41.463428/-75.05039

Station 43N – Lackawaxen River, Lackawaxen Township; 41.470209/-75.131452

Fish

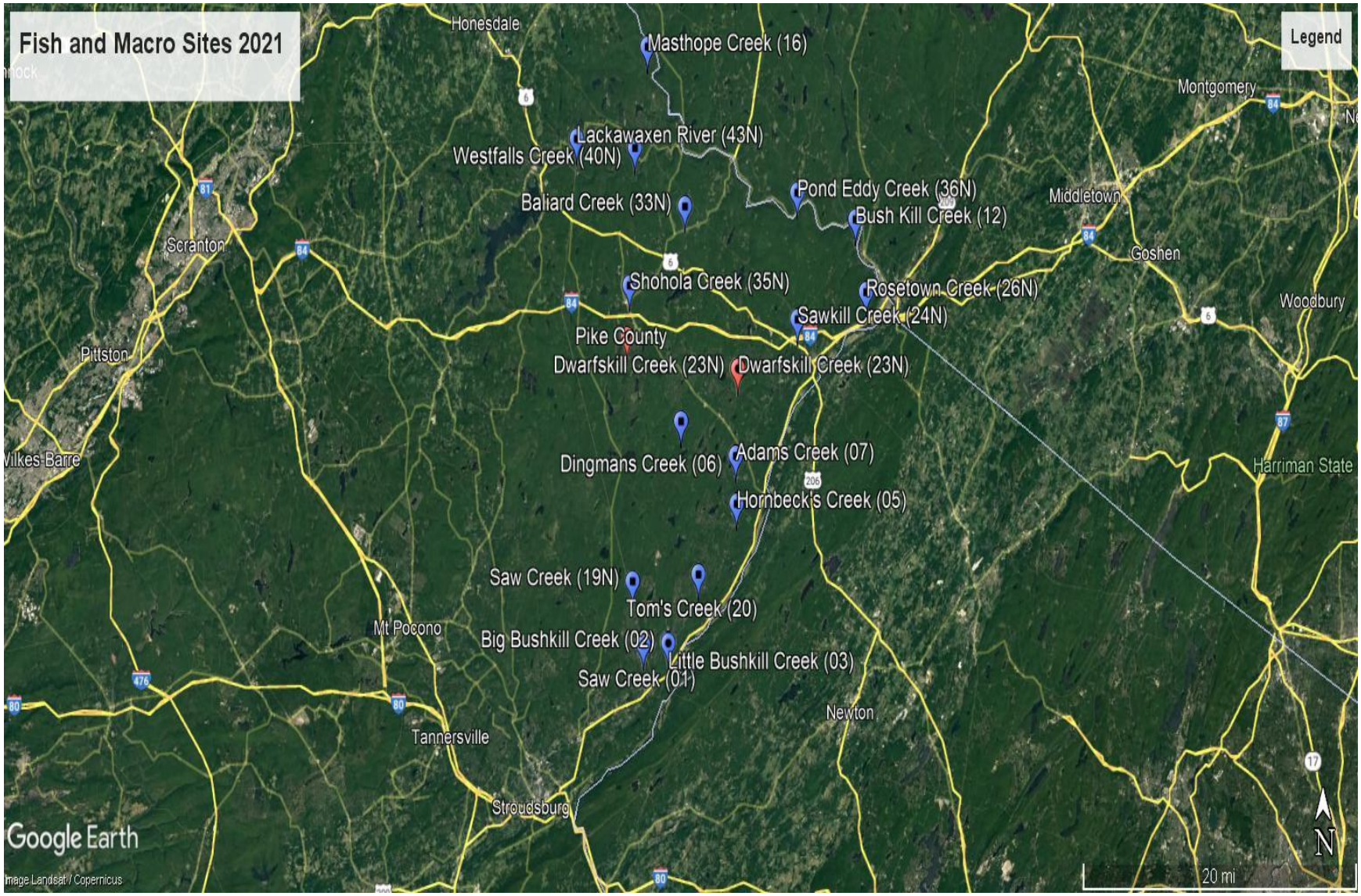
Station 01 – Saw Creek, Lehman Township; 41.089659/-75.038688

Station 19N – Saw Creek, Lehman Township; 41.137486/-75.053638

Station 23N – Dwarfskill Creek, Dingmans Township; 41.297113/-74.907403

Station 35N – Shohola Creek, Blooming Grove Township; 41.359891/-75.057742

Station 36N – Pond Eddy Creek, Shohola Township; 41.429517/-74.824731


Fish and Macro Sites 2021
Legend
Honesdale
Masthope Creek (16)
Lackawaxen River (43N)
Westfalls Creek (40N)
Baliard Creek (33N)
Pond Eddy Creek (36N)
Bush Kill Creek (12)
Middletown
Montgomery
Goshen
Scranton
Shohola Creek (35N)
Rosetown Creek (26N)
Sawkill Creek (24N)
Woodbury
Pike County
Dwarfskill Creek (23N)
Dwarfskill Creek (23N)
Pittston
Wilkes Barre
Dingmans Creek (06)
Adams Creek (07)
Harriman State
Hornbeck's Creek (05)
Saw Creek (19N)
Tom's Creek (20)
Mt Pocono
Big Bushkill Creek (02)
Little Bushkill Creek (03)
Saw Creek (01)
Newton
Tannersville
Stroudsburg
Google Earth
Image Landsat / Copernicus
20 mi
N

RESULTS AND DISCUSSION

Physical – Chemical Field Data

Physical and chemical parameters measured were similar at both baseline and non-point stream sites surveyed (Table 4). Temperature and dissolved oxygen levels were considered adequate for stream life at the time of sampling. All streams were considered close to neutral (7.0 pH units) with low buffering capability (alkalinity). pH readings at most sites were typical for the Pocono region. Conductivity readings at each site were generally low suggesting limited concentrations of dissolved or filterable solids such as minerals, metals, or man-made wastes. The mean value of the world's rivers contains an average of 120 parts per million (ppm) of total dissolved solids (Cole, 1983). A comparable conductivity would equal 240 µmhos/cm.

Habitat

Five of the 23 stream sites sampled scored below the optimal range of 192 for habitat - Table 5, Appendix B (PADEP, 2007). They included Raymondskill Creek (08), Saw Creek (19N), Rosetown Creek (20N), Shohola Creek (35N), and the Lackawaxen River (43N). Diverse habitat is considered a necessary component to healthy stream conditions. Habitat can be degraded by human activities within a watershed; however, natural events may also degrade habitat at certain times (i.e. floods, dewatering due to drought, pest infestations, etc.).

Habitat scores for Pike County streams have averaged 216 and this average has ranged from 196 to 232 units (Ersbak, 2010-2020). Subjective scoring criteria by different field teams has been fairly consistent.

Benthic Macroinvertebrates

Appendix A shows the taxa, numbers, and pollution tolerance values for the benthic macroinvertebrates from 9 baseline and 9 non-point stream site in Pike County for 2021. Table 6 shows the raw metric values and the adjusted standardized index of biotic integrity (IBI) score for each sample. At five of the following 18 sites fewer than 160 organisms were collected: Little Bushkill (03), Hornbeck's (05), Adams (07), Masthope (16), and Saw (19N) Creek. Therefore, the IBI should be interpreted cautiously at these sites due to the less than recommended sample size of 160 organisms used for the analysis (PADEP, 2009).

All stations exceeded the scoring IBI benchmark of $\geq$43 (<51 square miles drainage area) and $\geq$ 50 (>50 square miles drainage area) for attaining aquatic life use and impairment for the cold water fishes (CWF), warm water fishes (WWF), and trout stocking (TSF) protected uses (PADEP, 2009). Pond Eddy Creek (36N), Bush Kill Creek (12), Tom's Creek (20N), Sawkill Creek (24N), Balliard Creek (33N), and Westfalls Creek (40N) had the highest IBI scores of 89.8, 89.1, 87.3, 85.5, 82.3, and 80.4 respectively. Rosetown Creek (26N), Dingmans Creek (06), Shohola Creek (35N) and Hornbeck's Creek (05) had the lowest scores of 58.1, 65.0, 65.1 , and 63.5, respectively.

Table 4. Physical and chemical field data from twenty-three Pike County stream sites (2021) Pennsylvania Department of Environmental Protection 2009.

PARAMETER	STA. 01 Saw	STA. 02 Big Bushkill	STA. 03 Little Bushkill	STA. 05 Hornbecks	STA. 06 Dingmans	STA. 07 Adams
Sample Date	4/27/21	4/27/21	4/27/21	5/6/21	5/6/21	5/11/21
Temperature (°C)	9.6	12.6	12.2	12.7	13.3	10.7
Dissolved Oxygen (mg/l)	13.16	12.73	11.85	10.86	11.05	11.75
pH	7.04	7.01	6.40	6.94	7.04	6.75
Conductivity (µmhos/cm)	74.6	56.3	45.6	120.2	62.9	73.1
Alkalinity (mg/l)	20	15	15	15	20	15
PARAMETER	STA. 08 Raymondskill	STA 12 Bush Kill	STA. 16 Masthope	STA.19N Saw	STA 20N Toms	STA 24N Sawkill
Sample Date	4/21/21	4/15/21	5/3/21	4/27/21	4/13/21	4/30/21
Temperature (°C)	11.1	10.1	13.1	9.8	9.9	13.8
Dissolved Oxygen (mg/l)	11.85	12.16	11.03	12.51	12.08	11.04
pH	7.35	6.50	6.66	6.93	7.06	7.03
Conductivity (µmhos/cm)	101.4	29.5	46.9	34.5	106.8	81.7
Alkalinity (mg/l)	15	10	15	15	15	17.5

PARAMETER	STA. 26N Rosetown	STA. 33N Balliard	STA. 35N Shohola	STA. 36N Pond Eddy	STA. 40N Westfalls	STA. 43N Lackawaxen
Sample Date	4/26/21	5/11/21	4/13/21	4/26/21	5/3/21	5/3/21
Temperature (°C)	7.9	11.2	10.1	9.6	11.8	13.8
Dissolved Oxygen (mg/l)	12.67	11.96	12.19	12.84	11.9	11.49
pH	6.94	6.47	6.32	6.77	6.96	7.33
Conductivity (µmhos/cm)	29.2	49.6	51.8	24.7	102.5	79.0
Alkalinity (mg/l)	10	12.5	7.5	15	17.5	30

Table 4. (cont.)

PARAMETER	STA. 01 Saw	STA.19N Saw	STA. 23N Dwarfskill	STA. 35N Shohola	STA. 36N Pond Eddy	
Sample Date	9/21/21	9/21/21	9/30/21	9/21/21	9/30/21	
Temperature (°C)	16.5	18.1	14.9	15.6	13.1	
Dissolved Oxygen (mg/l)	9.23	7.69	9.16	8.28	9.99	
pH	6.23	6.06	7.23	5.2	7.27	
Conductivity (µmhos/cm)	75.5	35.3	111.2	54.2	26.9	
Alkalinity (mg/l)	20	15	15	10	20	

Table 5. Habitat assessment of 23 sampling stations on Pike County streams (2021) - Pennsylvania Department of Environmental Protection, 2009.

HABITAT PARAMETER	STA 01 Saw 4/27/21	STA 02 Big Bushkill 4/27/21	STA 03 Little Bushkill 4/27/21	STA 05 Hornbecks 5/6/21	STA 06 Dingmans 5/6/21	STA 07 Adams 5/11/21
1. Instream Cover	19	16	18	15	19	17
2. Epifaunal Substrate	20	20	19	15	19	18
3. Embeddedness	17	17	16	18	16	16
4. Velocity/Depth Regimes	19	15	19	15	18	14
5. Channel Alteration	16	18	19	15	19	15
6. Sediment Deposition	14	15	10	14	15	8
7. Frequency of Riffles	18	19	20	18	19	13
8. Channel Flow Status	19	18	19	20	20	19
9. Condition of Banks	15	13	15	16	12	11
10. Bank Vegetative Protection	17	20	18	15	20	18
11. Grazing or Other Disruptive Pressure	19	19	19	18	19	19
12. Riparian Vegetative Zone Width	17	15	13	13	19	15
TOTAL SCORE	**210**	**205**	**205**	**192**	**215**	**183**

HABITAT PARAMETER	STA 08 Raymondskill 4/21/21	STA 12 Bush Kill 4/15/21	STA 16 Masthope 5/3/21	STA 19N Saw 4/27/21	STA 20N Toms 4/13/21	STA 24N Sawkill 4/30/21
1. Instream Cover	16	20	19	16	19	17
2. Epifaunal Substrate	13	20	18	17	19	20
3. Embeddedness	17	19	17	17	19	18
4. Velocity/Depth Regimes	7	15	20	15	15	12
5. Channel Alteration	13	15	18	15	20	15
6. Sediment Deposition	16	19	15	17	19	15
7. Frequency of Riffles	14	20	19	16	20	18
8. Channel Flow Status	20	20	19	20	19	18
9. Condition of Banks	17	14	15	15	10	17
10. Bank Vegetative Protection	18	15	19	13	15	19
11. Grazing or Other Disruptive Pressure	13	18	19	18	18	19
12. Riparian Vegetative Zone Width	13	13	15	11	20	15
TOTAL SCORE	**177**	**208**	**213**	**190**	**213**	**203**

Table 5. (cont.).

HABITAT PARAMETER	STA 26N Rosetown 4/26/21	STA 33N Balliard 5/11/21	STA 35N Shohola 4/13/21	STA 36N Pond Eddy 4/26/21	STA 40N West Falls 5/3//21
1. Instream Cover	15	19	17	20	17
2. Epifaunal Substrate	18	19	18	19	19
3. Embeddedness	18	18	15	19	18
4. Velocity/Depth Regimes	20	18	14	19	17
5. Channel Alteration	16	16	16	19	18
6. Sediment Deposition	19	13	7	19	13
7. Frequency of Riffles	18	20	18	20	20
8. Channel Flow Status	15	20	19	19	15
9. Condition of Banks	5	13	13	15	13
10. Bank Vegetative Protection	8	17	17	19	18
11. Grazing or Other Disruptive Pressure	18	18	18	19	19
12. Riparian Vegetative Zone Width	14	15	15	19	15
TOTAL SCORE	**184**	**206**	**187**	**226**	**202**

HABITAT PARAMETER	STA 43N Lackawaxen 5/3/21	STA 01 Saw 9/21/21	STA 19N Saw 9/21/21	STA 23N Dwarfskill 9/30/21	STA 35N Shohola 9/21/21	STA 36N Pond Eddy 9/30/21
13. Instream Cover	13	19	20	17	15	17
14. Epifaunal Substrate	16	20	19	20	18	20
15. Embeddedness	14	15	19	16	17	20
16. Velocity/Depth Regimes	13	15	20	17	18	16
17. Channel Alteration	17	15	16	15	18	20
18. Sediment Deposition	13	20	20	15	19	20
19. Frequency of Riffles	18	20	17	20	20	20
20. Channel Flow Status	19	15	19	19	20	19
21. Condition of Banks	15	18	15	19	19	10
22. Bank Vegetative Protection	18	10	5	10	10	10
23. Grazing or Other Disruptive Pressure	18	20	14	13	20	20
24. Riparian Vegetative Zone Width	15	10	16	12	13	20
TOTAL SCORE	**189**	**197**	**200**	**193**	**207**	**212**

Score ranges: Optimal 240-192, Suboptimal 180-132, Marginal 120-72, Poor <60

Table 6. Metric scores for eighteen benthic macroinvertebrate samples from Pike County stream sites (April/May, 2021).

METRIC	STA. 01 Saw	STA. 02 Big Bushkill	STA. 03 Little Bushkill	STA. 05 Hornbecks	STA. 06 Dingmans	STA. 07 Adams
Total Taxa Richness	24	24	21	15	21	20
Diversity Index	2.56	2.19	2.32	1.93	1.93	2.57
EPT Taxa Richness	15	19	13	12	16	13
Hilsenhoff Biotic Index	3.39	3.62	2.34	2.97	4.29	2.93
Percent Intolerant	50.27	34.78	57.05	59.06	31.25	50.36
Modified Beck's Index	25	25	25	18	25	14
Index of Biotic Integrity	**74.69**	**66.57**	**73.73**	**63.53**	**65.01**	**66.68**

METRIC	STA. 08 Raymondskill	STA. 12 Bush Kill	STA. 16 Masthope	STA.19N Saw	STA.20N Toms	STA. 24N Sawkill
Total Taxa Richness	29	28	19	17	23	26
Diversity Index	2.43	2.56	1.96	1.65	2.30	2.65
EPT Taxa Richness	18	21	17	12	16	17
Hilsenhoff Biotic Index	4.06	2.44	2.88	2.10	1.48	2.50
Percent Intolerant	39.90	65.99	55.17	82.35	83.26	64.20
Modified Beck's Index	20	40	20	15	33	31
Index of Biotic Integrity	**72.85**	**89.10**	**70.31**	**67.66**	**87.28**	**85.52**

METRIC	STA. 26N Rosetown	STA 33N Balliard	STA. 35N Shohola	STA. 36N Pond Eddy	STA. 40N Westfalls	STA. 43N Lackawaxen
Total Taxa Richness	17	27	22	25	21	17
Diversity Index	1.67	2.47	2.46	2.39	2.49	2.36
EPT Taxa Richness	10	20	10	17	16	11
Hilsenhoff Biotic Index	5.02	3.35	3.09	1.03	2.59	3.89
Percent Intolerant	49.51	48.54	63.58	87.83	62.07	34.76
Modified Beck's Index	24	32	11	41	30	15
Index of Biotic Integrity	**58.10**	**82.30**	**65.06**	**89.79**	**80.38**	**69.51**

None of the eighteen sites showed significantly higher IBI scores from the last 11+ years sampled. Eight of the sites showed significantly lower IBI scores. They included Adams Creek (07), Big Bushkill Creek (02), Hornbeck's Creek (05), Little Bushkill Creek (03), Masthope Creek (16), Rosetown Creek (26N), Saw Creek (01), and Saw Creek (19N). Four of these sites (Adams, Hornbeck's, Masthope, and Saw Creek (19N)) had fewer than the 160 organisms required for good statistical analysis.

FISH

Five stream fish communities in Pike County were assessed by electrofishing techniques. Each survey site was categorized into habitat categories based on stream width (wetted perimeter) to allow for comparative assessments of biotic integrity among streams (Table 7). The streams surveyed fell into one of five width categories ranging from 1 (<10 feet) to 5 (>60 feet). Of the five stream stations, Saw Creek (01) and Dwarfskill Creek (23N) had more than three upstream impoundments and the remainder had three or less. The watershed for each site ranged from 7 to 30 square miles.

Trout species were present at two of the five stream sites surveyed. Native brook trout were not collected at any site. Wild brown trout were collected from Saw Creek (01) and Pond Eddy Creek (36N). Two young-of-year brown trout were collected from Pond Eddy Creek (36N).

Table 7. Stream fish communities sampled for width category, impoundments in watershed, drainage area (square miles), and game fish present in Pike County, PA (September, 2021).

STREAM SAMPLED	SITE ID	WIDTH CATEGORY	IMPOUNDMENTS ABOVE SAMPLE SITE	DRAINAGE BASIN AREA (square miles)	GAME FISH PRESENT
Saw	01	2	>3	30	Brown trout
Saw	19N	5	2	24	
Dwarfskill	23N	2	>3	7	
Shohola	35N	4	3	26	
Pond Eddy	36n	2	1	7	Brown trout

Trout are an important sport fish in the region, are temperature sensitive and prefer streams where thermal conditions seldom exceed 65 degrees Fahrenheit (Scott and Crossman, 1979). Impoundments with surface water releases tend to discharge warm water during the summer months, which is considered detrimental to the natural survival and production of trout. Sedimentation of streams is also detrimental to the survival of trout, as they require a clean substrate to incubate their eggs. Brook trout are less tolerant to thermal stress and sedimentation than brown trout and are usually associated with springs and headwater regions of watersheds. Brook trout also require high concentrations of dissolved oxygen to survive. Therefore, brook trout are usually associated with clean water conditions and are fairly intolerant to organic pollutants.

A total of 12 species of fish were collected from the five streams surveyed in September of 2021 (Table 8). Blacknose dace were the dominant forage fish and found at all five sites. The American eel (*Anguilla rostrata*), which is a catadromous fish (living in fresh water and spawning in salt water), was found at Saw Creek (01) and Pond Eddy Creek (36N). Both were proximal to the Delaware River. Both Saw Creek sites (01 and 19N) had the greatest diversity of fish with 7 species present.

Fish species were classified for calculation of an index of biotic integrity at each station surveyed (Table 9). These categories included pollution tolerance, trophic position (carnivore, omnivore or insectivore), thermal tolerance (stenothermal vs. eurythermal), adaptability to changing conditions (pioneer), spawning requirements (lithophil), and salmonid reproductive capacity (presence of young-of-year) – Lyons et al., 1996, Scott and Crossman, 1979; Plafkin et al., 1989; and Cooper, 1983.

The index of biotic integrity for the five (5) stream sites surveyed ranged from eighteen at Saw Creek (19N) and Dwarfskill Creek (23N) to twenty-three at Pond Eddy Creek (36N) – Table 9. Only the Pond Eddy site had an IBI index considered good ($\geq$21) and approximating that found in high quality streams of the region. All five sites had IBI scores that were significantly lower than previous years sampled (Ersbak, 1995-2020). The number of fish collected over the 20-minute time allotment was historically low for all sites surveyed. This may be a reflection of poor sampling conditions (i.e. high water and flows) and could explain the depressed IBI indices.

It is noteworthy, that of the 164 individual fish sampled, no external deformities (tumors, ulcers, etc.) indicative of stress resulting from chemical or physical pollutants were observed.

Table 8. Fish species collected from five stream sites in Pike County, PA (September, 2021).

		9/21/21	9/21/21	9/30/21	9/21/21	9/30/21
Scientific Name	Common Name	Saw 01	Saw 19N	Dwarfskill 23N	Shohola 35N	Pond Eddy 36N
Anguilla rostrata	American eel	16				3
Catostomus commersoni	white sucker		1			
Rhinichthys atratulus	blacknose dace	46	4	45	1	1
Rhinichthys cataractae	longnose dace	5				
Salmo trutta	brown trout	1				3
Exoglossum maxillingua	cutlips minnow	1	13			1
Semotilus atromaculatus	creek chub		1			
Etheostoma olmstedi	tessellated darter	1				
Luxilus cornutus	Common shiner	1	1		2	
Semotilus corporalis	Fallfish				4	
Lepomis gibbosus	pumpkinseed		4			
Noturus insignis	margined madtom		4		4	
	TOTAL	**71**	**28**	**45**	**11**	**8**

TABLE 9. Index of biotic integrity (IBI) test scores at 5 stream sites in Pike County, Pennsylvania (September, 2021).

IS	Number of intolerant species
TOL	% of individuals that are tolerant species
CARN	% of individuals that are top carnivore species
STENO	% of individuals that are stenothermal coolwater & coldwater species
ST	% of salmonid individuals that are brook trout
I	% of individuals that are insectivores
P	% of individuals that are pioneering species
CPE	Catch per 20 minute effort
L	% of individuals that are lithophilic spawners
YOY	Number of young-of-year trout

INDEX OF BIOTIC INTEGRITY

STATION 01 — Saw Creek

IBI Metrics	Metric Value	Test Score
IS	1	3
TOL	65	1
CARN	24	5
STENO	46	3
ST	0	1
I	34	1
P	89	1
CPE	71	1
L	76	3
YOY	0	1
IBI Score =		**20**

STATION 19N — Saw Creek

Metric Value	Test Score
2	3
21	3
0	1
25	1
0	1
32	1
18	5
28	1
71	1
0	1
	18

STATION 23N — Dwarfskill Creek

Metric Value	Test Score
0	1
100	5
0	1
0	1
0	1
0	1
100	1
45	1
100	5
0	1
	18

STATION 35N — Shohola Creek

IBI Metrics	Metric Value	Test Score
IS	1	3
TOL	9	3
CARN	0	1
STENO	0	1
ST	0	1
I	91	5
P	9	5
CPE	11	1
L	64	1
		21

STATION 36N — Pond Eddy Creek

Metric Value	Test Score
2	3
12	3
75	5
88	5
0	1
38	1
50	3
8	1
63	1
	23

RECOMMENDATIONS

PCCD should continue its monitoring program of streams and rivers in the County. The cyclical rotation schedule of sites to be surveyed should be reviewed, and a schedule of sampling established. It is important that all macroinvertebrate samples be collected between mid-April and the end of May as per PADEP protocols. Samples should be collected when conditions permit. High water or spate conditions should be avoided whenever possible. Fish should be collected at the season low water mark, typically in August or September. This sampling schedule will maintain consistency with previous years of study and allow for better comparative analysis.

Based on historical data it is suggested the following be included in the 2022 sampling rotation for macroinvertebrate and fish populations:

Macroinvertebrates

- Cummins (11)
- Vandermark (10)
- Shohola (14)
- Dingmans (22N)
- Westcolang (28N)
- Rattlesnake (38N)
- East Branch Wallenpaupack (18)
- Sawkill (09)
- Vandermark (25N)
- Lackawaxen (15)
- Dwarfskill (23N)
- Teedyuskung (29N)
- Little Bushkill (44N)
- Toms (4)
- Twin Lakes (13)
- Wallenpaupack (17)
- Walker Lake (27N)
- Kleinhans (30N)

Fish

- Hornbecks (05)
- Westcolang (28N)
- Rattlesnake (38N)
- Bush Kill (12)
- Teedyuskung (29N)
- Twin Lakes (13)
- Balliard (33N)

The watershed of each sampling site should be mapped and further delineated by basin characteristics for both fish and macroinvertebrates. These data will assist in the interpretation of water quality indices. The USGS Streamstats Program (http://streamstats.usgs.gov/ss/) is an available software tool for this purpose.

Further testing should be considered for other new or existing stream sites threatened by environmental impacts or significant land use changes. Proposed large development projects should be considered in scheduling additional special study sites in the County's water quality monitoring program.

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Appendix A.

Taxa, numbers, and pollution tolerance values for the benthic macroinvertebrates from eighteen stream sites in Pike County for 2021.

TAXON ORDER *GENERA/SPECIES*	POL. TOL.	01	02	03	05	06	07	08	12	16	19N	20N	24N
AMPHIPODA (shrimp)													
Gammarus spp.	4				4								
COLEOPTERA (beetles)													
Stenelmis spp.	5	22	6	1		9	2	19				4	2
Promoresia spp.	2	2			3			4					2
Optioservus spp.	4	1			10		9				1		2
Psephenus herricki	4	2	1	5		4	7	1			1	8	2
DIPTERA (true flies)													
Chironomidae	8	33	49	6		86	6	71	27	28		7	22
Blepharicera spp.	0	5	3	7					12			10	5
Hexatoma spp.	2			1					2			8	1
Atherix spp.	2										1		
Dicranota spp.	3			1									1
Antocha spp	3							8					
Empididae	6							1					
Prosimulium spp.	2	21		2				5	2	2	1	18	19
Simulium spp.	6	16	3			2	1	9	32		8		
EPHEMEROPTERA (mayflies)													
Epeorus spp.	0	10	7	9	1	1			45	2	3	82	22
Mccaffertium spp.	3	2	4	1		2		3	3	2	8		1
Ephemerella spp.	1	27	30	44	50	14	20	27	24	55	90	28	18
Eurylophella spp.	4			10	1	1		1					
Drunella spp.	1	3	1	7		4		10		3	2	4	8
Seratella spp.	2	11	2			1	3		1	1			2
Cinygmula spp.	1								2			9	
Paraleptophlebia spp.	1	2	6					1	3	1		16	15
Rithrogena spp.	0			1									
Isonychia spp.	3	1	2			3	2	5	3	1	15	2	1
Ameletus spp.	0							1				1	
Baetis spp.	6				38		28		1	8	4	16	9
Habrophlebiodes spp.	6						1	5					
Acerpenna spp.	6			1							6		
Diphetor spp.	6											2	
Acentrella spp.	4	16	67	34	6	7	5			26			18
LEPIDOPTERA (moths)													
Langessa spp.	5							1					
MEGALOPTERA (hellgrammites)													
Nigronia spp.	2						1						

TAXON ORDER *GENERA/SPECIES*	POL. TOL.	01	02	03	05	06	07	08	12	16	19N	20N	24N
Odonata (dragonflies)													
Aeshna spp.	5							1					
Gomphidae	4						3						
Boyeria spp.	2								1				
Lanthus spp.	5							1					
OLIGOCHATA (worms)	10	1		1		1			1			1	1
PLECOPTERA (stoneflies)													
Leuctra spp.	0		1		1	6	8		1			1	1
Amphinemura spp.	3	2			7	5					1		
Pteronarcys spp.	0				1				2		3		
Acroneuria spp.	0	2	1	8	2	2	10	4	5	5			1
Paragnetina spp.	1	1	3	1					2	2		1	
Agnetina spp.	1		1							1		1	1
Perlinella spp.	2								2				
Suwallia/Sweltsa spp.	0					5			6			5	2
Taeninonema spp.	3							5	1				
Cultus spp.	2									1			
Tallaperla spp	0							1					
Diura spp.	2		2										
Isoperla spp.	2	1	5		21	1	10	1	3	2		4	3
TRICHOPTERA (caddisflies)													
Chimarra spp.	4		1				4	4		1			
Dolophilodes spp.	0						16		3				1
Neophylax spp.	3		3										
Hydropsyche spp.	5				2		2	1					
Ceratopsyche spp.	5		2	6				1	3	1	7		2
Cheumatopsyche spp.	6	3	5					2	3				1
Diplectrona spp.	0			2		2			4			1	
Macrostemum spp.	6							1					
Rhyacophila spp.	1	4	2		2	3	1	4	3	3	1	4	
Lype spp.	2												
Lepidostoma spp.	1	1				1							
Lype spp.	2										1		
Protoptila spp.	1			1									
TOTAL		189	207	149	149	160	139	198	197	145	153	223	162

METRICS	01	02	03	05	06	07	08	12	16	19N	20N	24N
Total Taxa Richness	24	24	21	15	21	20	29	28	19	17	23	26
Shannon Diversity Index	2.56	2.19	2.32	1.93	1.93	2.57	2.43	2.56	1.96	1.65	2.30	2.65
EPT Taxa Richness	15	19	13	12	16	13	18	21	17	12	16	17
Hilsenhoff Biotic Index	3.39	3.62	2.34	2.97	4.29	2.93	4.06	2.44	2.88	2.1	1.48	2.50
Percent Intolerant Individuals	50.27	34.78	57.05	59.06	31.25	50.36	39.90	65.99	55.17	82.35	83.26	64.20
Modified Beck's Index	25	25	25	18	25	14	20	40	20	15	33	31
Index of Biotic Integrity	74.69	66.57	73.73	63.53	65.01	66.68	72.85	89.10	70.31	67.66	87.28	85.52

TAXON ORDER *GENERA/SPECIES*	POL TOL.	26N	33N	35N	36N	40N	43N		
AMPHIPODA (scuds)									
Gammarus spp.	4	1							
COLEOPTERA (beetles)									
Stenelmos spp.	5		12	6			24		
Optioservus spp.	4			2	1		1		
Promoresia spp.	2			32	4		1		
Anchytarsus spp.	5				1				
Psephenus herricki	4	1	3		3				
Ectopria spp.	2				1				
COLLEMBOLA (springtails)									
Podura aquatica	9	94							
DIPTERA (true flies)									
Chironomidae	8	3	68	16	5	10	21		
Antocha spp.	3		2						
Muscidae	6						1		
Dicranota spp.	3			6		1			
Tipula spp.				2					
Blepaharicera spp.	0	5			4	10			
Prosimulium spp.	2	53		2		14			
Simulium spp.	6			4			23		
EPHEMEROPTERA (mayflies)									
Epeorus spp.	0	18	6		46	36	15		
Mccaffertium spp.	3		3	2			15		
Ephemerella spp.	1	7	6	49	32	8	14		
Drunella spp.	1		11			4	7		
Serratella sopp	2		8			2			
Eurylophella spp.	4						23		
Cinygmula spp.	1	10			5				
Paraleptophlebia spp.	1		1		9				
Isonychia spp.	3		1			1			
Baetis spp.	6	3			11	40			
Acentrella spp.	4		4			7			
Diphetor spp	6				1	8			
ISOPODA (sow bugs)									
Caecidotea spp.	6	1							
MEGALOPTERA (hellgrammites)									
Nigronia spp.	2			4	1				
Corydalus spp.	4		2						
ODONATA (dragonflies)									
Gomphidae	4		1	1		1			
Boyeria spp.				3					

TAXON ORDER *GENERA/SPECIES*	POL. TOL.	26N	33N	35N	36N	40N	43N
OLIGOCHAETA (worms)	10			9			
PLECOPTERA (stoneflies)							
Leuctra spp.	0		33		5	11	
Pteronarcys spp.	0				3	2	
Paragnetina spp.	1		2	3			
Tallaperla spp.	0	1			2		
Acroneuria spp.	0		14	4	3	4	2
Suwallia/Sweltsa spp.	0	2			3	3	
Amphinemura spp.	3	1	1			3	
Taenionema spp	3			1			
Isoperla spp.	2	1		8		5	
TRICHOPTERA (caddisflies)							
Chimarra spp.	4		4	9			1
Dolophilodes spp.	0	2	4		1		
Hydropsyche spp.	5						1
Ceratopsyche spp.	5		1	5			
Cheumatopsyche spp.	6		2	4	1		
Diplectrona spp.	0	1	1		41	3	
Wormaldia spp.	0		1				
Neophylax spp.	3				2		
Psilotreta spp.	0				2		
Rhyacophila spp.	1		3		2	1	1
Agapatus spp.	5		3				
Pycnopsyche spp.				1			
Brachycentrus spp.	1						2
TOTAL		204	206	173	189	174	164

METRICS	26N	33N	35N	36N	40N	43N
Total Taxa Richness	17	27	22	25	21	17
Shannon Diversity Index	1.67	2.47	2.46	2.39	2.49	2.36
EPT Taxa Richness	10	20	10	17	16	11
Hilsenhoff Biotic Index	5.02	3.35	3.09	1.03	2.59	3.89
Percent Intolerant Individuals	49.51	48.54	63.58	87.83	62.07	34.76
Modified Becks Index	24	32	11	41	30	15
Index of Biotic Integrity	58.10	82.30	65.06	89.79	80.38	69.51

Appendix B

Taxa, numbers, and site description for the five electrofishing stream sites in Pike County for 2021.

FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY

Stream/River – Saw Creek | Township - Lehman | DEP Water Use Classification HQCWF

Site I.D. #01 | Date – 9/21/21

Location – 41.089659/-75.038688

Sampling duration – 20 minutes | Sampling Distance – 150 feet

Sampling area (ft2) – 2,850 | Mean Stream Width – 19 feet

Weather /Comments – cloudy, sun came out while sampling

Temperature – 25.6 Celsius | Dissolved Oxygen – 9.23 ppm | pH – 6.23

Gear used - DC Electroshocker | Habitat rating – 197 | Conductivity- 75.5 uS/cm

Voltage – 300 | Stream Width Category - 2

Scientific Name Genus/Species	Common Name	Number Collected	Number of Anomalies
Anguilla rostrate	American eel	16	0
Noturus insignis	Brown trout (adult)	1	0
Etheostoma olmstedi	Tesselated darter	1	0
Rhinichthys cataractae	Longnose dace	5	0
Exoglossum maxilingua	Cutlips minnow	1	0
Rhinichthys atratulus	Blacknose dace	46	0
Luxilus cornutus	Common shiner	1	0
	TOTAL	**71**	

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Saw Creek | Township - Lehman | DEP Water Use Classification HQCWF

Site I.D. #19N | Date – 9/21/21

Location – 41.137486/-75.053638

Sampling duration – 20 minutes | Sampling Distance – 205 feet

Sampling area (ft2) – 13,325 | Mean Stream Width – 65 feet

Weather /Comments – partly sunny, windy

Temperature – 18.1 Celsius | Dissolved oxygen – 7.69 ppm | pH – 6.06

Gear used - Backpack Electroshocker | Habitat rating – 200 | Conductivity- 35.3 uS/cm

Voltage – 300 | Stream Width Category - 5

Scientific Name Genus/Species	Common Name	Number Collected	Number of Anomalies
Exoglossum maxillingua	Cutlips minnow	13	0
Rhinichthys atratulus	Blacknose dace	4	0
Catostomus commersoni	White sucker	1	0
Noturis insignis	Margined madtom	4	0
Lepomis gibbosus	Pumpkinseed	4	0
Semotilus atromaculatus	Creek chub	1	0
Luxilus cornutus	Common shiner	1	0

TOTAL 28

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY
SURVEY

Stream/River – Dwarfskill Creek

Township - Dingmans

DEP Water Use Classification HQCWF

Site I.D. #23N

Date – 9/30/21

Location – 41.297113/-74.907403

Sampling duration – 20 minutes

Sampling Distance – 139 feet

Sampling area (ft2) – 3,614

Mean Stream Width – 26 feet

Weather /Comments – sunny, cool

Temperature – 14.9 Celsius

Dissolved oxygen – 9.16 mg/l

pH – 7.23

Gear used - Backpack Electroshocker

Habitat rating – 193

Conductivity- 111.2 uS/cm

Voltage - 250

Stream Width Category - 3

Scientific Name Genus/Species	Common Name	Number Collected	Number of Anomalies
Rhinichthys atratulus	Blacknose dace	45	0

TOTAL 45

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Shohola Creek Township - Shohola DEP Water Use Classification HQCWF

Site I.D. #35N Date – 9/21/21

Location – 41.359891/-75.057742

Sampling duration – 20 minutes Sampling Distance – 330 feet

Sampling area (ft2) – 18,150 Mean Stream Width – 55 feet

Weather /Comments - cloudy, breezy

Temperature – 15.6 Celsius Dissolved oxygen – 8.28 ppm pH – 5.80

Gear used - Backpack Electroshocker Habitat rating – 207 Conductivity- 54.2 uS/cm

Voltage – 300 Stream Width Category - 4

Scientific Name Genus/Species	Common Name	Number Collected	Number of Anomalies
Noturis insignis	Margined madtom	4	0
Semotilus corporalis	Fallfish	4	0
Luxilus cornutus	Common shiner	2	0
Rhinichthys atratulus	Blacknose dace	1	0

TOTAL 11

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.

FISH FIELD COLLECTION DATA SHEET

PIKE COUNTY WATER QUALITY SURVEY

Stream/River – Pond Eddy Creek | Township – Shohola | DEP Water Use Classification HQCWF

Site I.D. #36N | Date – 9/30/21

Location – 41.429517/-74.824731

Sampling duration – 20 minutes | Sampling Distance – 180 feet

Sampling area (ft2) – 3,600 | Mean Stream Width – 20 feet

Weather /Comments – sunny/chilly

Temperature – 13.1 Celsius | Dissolved oxygen – 9.99 ppm | pH – 7.27

Gear used - Backpack Electroshocker | Habitat rating – 212 | Conductivity- 26.9 uS/cm

Voltage - 250 | Stream Width Category - 2

Scientific Name Genus/Species	Common Name	Number Collected	Number of Anomalies
Anguilla rostrata	American eel	3	0
Salmo trutta	Brown trout (adult)	1	0
Salmo trutta	Brown trout (YOY)	2	0
Exoglossum maxillingua	Cutlips minnow	1	0
Rhynichthys atratulus	Blacknose dace	1	0

TOTAL 8

Anomalies = deformities, eroded fins, excessive mucous, fungus, reddening, tumors, and ulcers.