BIOLOGICAL STREAM SURVEY

# ESOPUS CREEK 2007

PREPARED FOR
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BY
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BIOLOGICAL STREAM SURVEY

# ESOPUS CREEK 2007

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*The cover photo was taken looking downstream of station 07A.*

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## SUMMARY

A water quality assessment of the Lower Esopus Creek and one of its tributaries, the Sawkill, was performed as part of a longitudinal assessment by the Lotic Scene Investigation™ (LSI) Program.

LSI is a water quality research program for college students. All students work with a professional aquatic biologist. The students and biologists produce independent reports. This report is based on the findings of a senior aquatic biologist from Watershed Assessment Associates. LSI monitors the Esopus in association with the State University of New York (SUNY) at New Paltz.

Physical, chemical and biological parameters were assessed at stations along the Lower Esopus Creek and one of its tributaries, the Sawkill.

All the stations in this survey had previously been assessed by the New York State Department of Environmental Conservation (NYS DEC) Stream Biomonitoring Unit in 1993 and 1996. Physical, chemical and biological data was collected and analyzed.

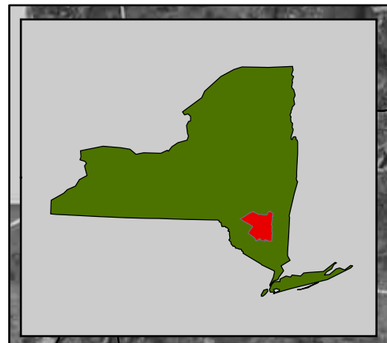
Water quality for this assessment ranged from non-impacted to moderately impacted, based on the benthic macroinvertebrate community. The most likely impacts, based on Impact Source Determination, are from impoundment effects, organic enrichment, complex municipal and industrial discharge, and non-point source nutrients.

Additionally, a new biotic index measure for nitrates and phosphates indicates that the Esopus' water quality changes from oligotrophic conditions at the most upstream station, to meso- and eutrophic conditions at the downstream stations.

Water quality on the Saw Kill, a tributary of the Esopus Creek, was non-impacted. The Nutrient Biotic Index indicates an oligotrophic condition. The Saw Kill station benthic macroinvertebrate community provides a model community that the Lower Esopus Creek could potentially achieve with reductions in pollutional stress.

## Background

The purpose of this study was to monitor water quality on the Lower Esopus Creek, using benthic macroinvertebrates, and to compare trend results from prior assessments. For a watershed map with sampling station locations, see **Figure 1**. The NYS DEC Stream Biomonitoring Unit Quality Assurance Work Plan for biological stream monitoring procedures was used for data collection and analysis (Bode et al., 2002).



Woodstock
Saugerties
Ashokan Reservoir
Olive
Hurley
Kingston (Town of)
Ulster
Kingston (City of)
Marbletown
Rosendale
Esopus
Sawkill Road
Sawkill-Ruby Road
Reservoir Road
Onteora Trail
Stony Creek
Hurley Mountain Road
Atwood
Tongore Road
Rondout Creek
Esopus Creek
Saw Kill
Plattekill Creek
HUDSON RIVER
ESOP-07A
ESOP-06
SAWK-01
ESOP-04
ESOP-03
ESOP-01
ESOP-02
28
28A
2A
87
209
213
5
4

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## Legend

**Sampling Locations**

**BAP**

- Non impacted
- Slightly impacted
- Moderately impacted
- Severely impacted
- Roads
- Rivers and Streams
- Surface Waters
- Municipal Boundaries

**Lower Esopus Watershed**

**Sub-Basin**

- Esopus Creek Proper
- Plattekill Creek
- Sawkill Creek

0 3,000 6,000 Feet

Figure 1

**Esopus Creek**
**2007 Biomonitoring Study**

**Ulster County, New York**

Base Map

Source:
NYS GIS Clearinghouse and CUGIR;
Sampling Locations were assessed by WAA;
Digital orthographic photos were taken in 2004 by NYS Office of Cyber Security & Critical Infrastructure Coordination.

The Lower Esopus Creek drainage area includes all land and water areas that drain surface water directly or indirectly to the Esopus Creek between its confluence with the Hudson River and the Ashokan Reservoir Dam, and the surface waters of the Mink Hollow Brook and all its tributaries above the point where it is diverted from its natural course to Cooper Lake.

The main stem of Lower Esopus Creek originates at the Olivebridge Dam in Olive, New York, the main outlet of the Ashokan Reservoir's West Basin. The reservoir is an over the top spillway that was built in stages from 1915 to 1926 to supply drinking water for New York City. The reservoir essentially severed the Esopus in half and changed its flow pattern and habitat. From below the dam to the confluence with the Hudson River, the main stem of the creek was altered from a cold-water fishery (trout) to a warm water fishery (small mouth bass). The Ashokan Reservoir is located at the eastern end of the Catskill Park. Although it is one of several drinking water supplies for New York City, the reservoir is included on the New York State 2006 list of impaired/TMDL waters due to sedimentation from bank erosion. From the spillway, Esopus Creek flows southeast to Marbletown before continuing northeast through the towns of Hurley, Ulster, and Kingston to its confluence with the Hudson River at Saugerties.

The Lower Esopus Creek watershed is composed of three sub-basins, including the Esopus Creek proper, Sawkill Creek, and Plattekill Creek drainages. The Esopus Creek proper drains an area of approximately 52,000 acres south of the Ashokan Reservoir. The Sawkill Creek watershed drains an area of approximately 26,700 acres to the north and east of the Ashokan Reservoir, through the towns of Woodstock and Kingston, meeting the Esopus Creek in Ulster. The Plattekill Creek watershed, northeast of the Sawkill drainage and westerly adjacent to Esopus Creek proper, drains an area of approximately 28,700 acres and discharges into the Esopus Creek in Saugerties.

Due to its desirable location, the area within the Lower Esopus Creek watershed is under pressure for development as a suburb of the greater New York metropolitan area. Increased growth rates resulting in increased impervious surfaces, traffic volumes and, consumption needs, and concentrated agricultural practices, will have an effect on the region's surface water and groundwater resources. Baseline documentation of these resources and effective monitoring strategies are important to future planning processes.

## METHODS

Each station was evaluated for percent canopy cover, current speed, percent of rock, rubble, gravel, sand, and silt, and the embeddedness of the substrate. The depth and width of the stream were also measured. Physical attributes were required to meet the habitat comparability criteria as outlined in Bode et al. (1990).

Water temperature (accuracy ± 0.2° C); specific conductance (range of 0 – 100 mS with a resolution of 4 digits); pH, with a range of 2 to 12 units (accuracy ± 0.2 units); and dissolved oxygen, with a range of 0 to 50 mg/L and an accuracy of ±0.2 mg/L, were obtained at each station using a Hydrolab™ Quanta® probe following the manufacturer calibration guidelines.

For physical and chemical data see appendix.

Macroinvertebrate samples were collected at each station using an 800-900 micron mesh kick net (9 by 18 inch). Samples were collected by disturbing the substrate by foot upstream of the net and continuing over a five-meter transect for five minutes, as described in the Quality Assurance Work Plan for Biological Stream Monitoring in New York State (Bode et al. 2002). Samples were separately preserved in 95% ethyl alcohol and were then sub-sampled in the lab by randomly selecting 15 cc of detritus from the sample and examining it under a dissecting microscope. Invertebrates larger than 1.5 mm were removed until 100 organisms were obtained for each sample. Macroinvertebrates were identified to genus/species level to determine the water quality category for each station and to determine the Impact Source Determination (ISD) described by Riva-Murry et al. (2002).

The metrics used to determine water quality were those recommended by the NYS DEC Stream Biomonitoring Unit with the exception that an all genera level identification was used instead of a combination of genera and species level identification. Identification to genera has been shown to have 100 percent accuracy in properly categorizing water quality in the NYS DEC four tiered method of assessment (J. Kelly Nolan, unpublished data).

The expected variability of single sample macroinvertebrate sampling results is stated in Smith and Bode (2004).

The four community metrics utilized for both genera level were: Richness (Plafkin et al. 1989), EPT richness (Lenat, 1987), Hilsenhoff's Biotic Index (Hilsenhoff, 1987), and Percent Model Affinity (PMA) (Novak and Bode, 1992).

**Table 1**

| Multi metrics used in NYS for kick samples and Biological Assessment Profile | |
|---|---|
| Genera Richness (GR) | is the total number of taxa found in the sub-sample. Higher richness values are mostly associated with clean water conditions. |
| EPT Richness (EPT) | is the number of different species or taxa in the three most pollution sensitive orders: Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies) that are present. Generally, the more EPT taxa, the better the water quality or the better the habitat. However, some pristine headwater streams may be naturally low in richness, due to a relative lack of food (quantity and different types) and generally lower abundance of organisms. |

| | |
|---|---|
| Biotic Index (BI) | is the Hilsenhoff Biotic Index and is calculated by multiplying the number of individuals of each species or taxa by its assigned tolerance value, summing these products, and dividing the total number of individuals. Tolerance values range from intolerant (0) to tolerant (10). High BI values are suggestive of organic (sewage) pollution, while low values indicate a lack of sewage effects. |
| Percent Model Community (PMA) | is a measure of similarity to a model non-impacted community based on percent abundance of seven major groups. The lower the similarity value the greater the impact. |
| Biological Assessment Profile (BAP) | is the assessed impact for each station. The BAP score is the mean value of the above 4 metrics after converting each metric score to a common scale of 0 - 10. The higher the BAP score the better the assessed impact category. There are four impact categories in NYS: non-, slightly, moderately, or severely impacted. |

The score for each particular metric from each station was used to calculate each station's Biological Assessment Profile (BAP) by converting each metric score to a common scale of 0 – 10. The BAP score categorizes the overall water quality assessment into one of four categories: non-, slightly, moderately, or severely impacted (Bode et al. 2002).

**Table 2**

| Abridged NYS DEC water quality category definitions | |
|---|---|
| Non-impacted | Indices reflect very good water quality. The macroinvertebrate community is diverse. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota. |
| Slightly impacted | Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation. |
| Moderately impacted | Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Water quality often is limiting to fish propagation, but usually not to fish survival. |
| Severely impacted | Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival. |

Impact Source Determination (ISD) was calculated for each station. ISD compares test station communities to model communities empirically derived from macroinvertebrate data; the greater the similarity of a test station community to a model community, the more likely a particular impact source is affecting the test community. Data is most conclusive if a test community exhibits at least 50% similarity to a model community (Bode et al. 2002). Riva-Murray et al. (2002) found that ISD correlated well with impairment sources inferred from chemical, physical, and watershed characteristics, and biomonitoring results.

The Nutrient Biotic Index (NBI) was also calculated for each station. NBI is a new measure of nutrient enrichment and is based on responses of the macroinvertebrate community to effects of increasing nutrient levels. NBI was developed by Smith et al.

(2007) for nitrate (NBI-N) and phosphorus (NBI-P). The measure is based on tolerance values that are assigned to each taxon. Values are on a 0 -10 scale with 0 being intolerant and 10 being tolerant. The determined value corresponds to a trophic state of enrichment for both NBI-N and NBI-P.

**Table 3**

| Trophic state for NBI | NBI-P | NBI-N |
|---|---|---|
| Eutrophic | > 6.0 | > 6.0 |
| Mesotrophic | 5.5 – 6.0 | 4.8 – 6.0 |
| Oligotrophic | < 5.5 | < 4.8 |

See appendix for the macroinvertebrate taxa list, BAP, ISD, and NBI results for each station.

## RESULTS

The Biological Assessment Profile (BAP) indicated non impacted water quality for the one station on the Sawkill tributary. Water quality of the six stations on the Lower Esopus Creek water quality was either slightly or moderately impacted (see **Figure 2**). Impact Source Determination suggested organic enrichment, complex municipal and industrial discharge, impoundment effects, and non-point source nutrients, or a combination of these conditions, as the likely impact sources. By the Nutrient Biotic Index for nitrogen and phosphorus, the Lower Esopus is adversely affected by nutrients. The condition of the stream was oligotrophic at the most upstream station, and meso- to eutrophic at the downstream stations.

The dissolved oxygen concentration ranged from 7.05 to 10.25 mg/l, and dissolved oxygen percent saturation ranged from 83.3 to 122.4 percent. Water temperature ranged from 23.02 to 26.45 degrees Celsius; specific conductance ranged from 113 to 296 µmhos/cm; and pH ranged from 7.38 to 8.55. Salinity ranged from 0.07 to 0.14 PSS. (See appendix for a chemical summary chart.)

## DISCUSSION

A notable decline in water quality occurs between Station 01, approximately 9 miles below the Ashokan Reservoir, and Station 02 (**Figure 2**). At Station 01 the BAP indicated slightly impacted (close to nonimpacted) water quality. The benthic macroinvertebrate community was diverse with 9 genera from the most sensitive groups of Mayflies, Stoneflies, and Caddisflies.

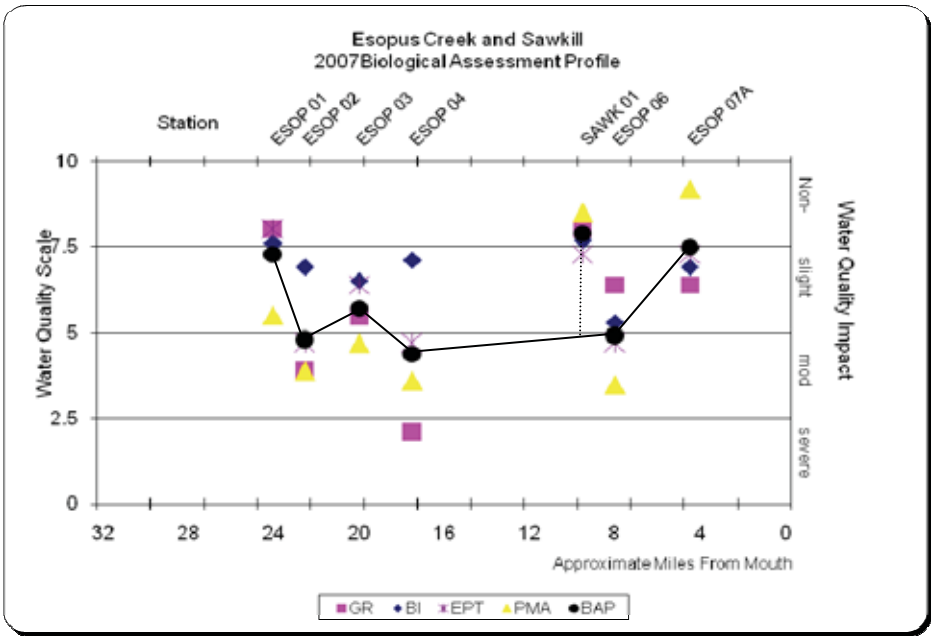


**Figure 2.** The biological assessment profile comprises four contributory indices that are determined from sub-samples of macroinvertebrates collected from each station. The solid line connects the BAP score between each station on the Esopus Creek. The dashed lines indicate the approximate location where the Sawkill enters the Esopus Creek.

Between Stations 01 and 02 water quality dropped to moderately impacted. In 1996, Bode attributed water quality changes at Station 02 (Station 01 was not assessed) to impoundment effects from the Ashokan Reservoir. Our data indicates the Ashokan Reservoir is not a primary influence on the benthic macroinvertebrate community at Station 02. There are local impoundments and sluggish areas just above Station 02 that are likely the major influence on water quality changes at the station.

Water quality improved slightly, by BAP, at Station 03. This might be due to increased distance from the upstream impoundments, though ISD continued to indicate impoundment and non point source nutrient effects. The NBI-N and P indicated meso- and eutrophic conditions, respectively, possibly because of an increase in nonpoint source nutrients as the stream moves further down the watershed through agricultural areas.

Water quality dropped back into the moderately impacted category at Station 04 with the lowest BAP score for this survey. ISD demonstrated impoundment, non-point source nutrients, organics, and complex inputs as the most likely stressors. Station 04 also had the lowest dissolved oxygen concentration and percent dissolved oxygen saturation levels, suggesting a higher biological oxygen demand may be occurring. It is beyond the scope of this study to determine whether any industrial facilities exist that might be impacting the water at this station, though we are not aware of any in this area. In 1996, Bode felt that the lower assessment might be secondary to agricultural runoff, which continues to be the most obvious probable source of impact.

Between Station 04 and 06 the Esopus continues to travel through agricultural areas. It also receives discharge from the Ulster County Sewer Improvement Area in Kingston.

Station 06 was moderately impacted. ISD was most similar to a community structure affected by siltation, non point source nutrients, and complex inputs. NBI-N and P indicated a eutrophic state of water quality. There were sewage-loving midges (*Dicrotendipes sp*. and *Parachironomus frequens*) present, and only one individual mayfly *(Baetis sp*.) was noted in the sub-sample. Similar results were found by Bode at both Station 05 (not assessed in this survey) and Station 06 in 1993. The decline in water quality at this station is probably due to the Ulster County Sewer Improvement Area discharge.

Water quality at Station 07A, approximately 3.25 miles below Station 06, is slightly better than water quality at Station 01, although still within the slightly impacted category. Water quality improvement might be due to the higher water volumes that enter the Lower Esopus from tributaries such as the Plattekill. The creek also travels through less agricultural area in this section. Riparian areas and physical habitat are better here.

Stoneflies were observed in both field and sub-samples at Stations 01 and 07A on the Esopus Creek and at Station 01 on the Saw Kill. They were not observed in field or sub-samples at Stations 02, 03, 04, and 06. Stoneflies are intolerant to declines in dissolved oxygen levels. Although diminished oxygen saturation was not measured at all of these stations, the levels may be fluctuating widely over a 24 hour period, an occurrence observed when increased nutrients promote algae growth. Algae increase oxygen levels by photosynthesis during daylight hours, but a precipitous drop in those levels can occur at night when photosynthesis ceases.

The Sawkill Station 01 was nonimpacted, with the highest water quality rating in this study. ISD indicated a community most similar to a natural, non impacted community structure. The station was oligotrophic by NBI-N and P.

This study indicates that both agricultural runoff and discharge from the Ulster County Sewer Improvement Area in Kingston are most likely contributing to declines in water quality on the Lower Esopus Creek.

## Rationale for Data Collected

### Physical

The *physical survey* is essential to a stream study because aquatic fauna often have specific habitat requirements independent of water composition, and alterations in these conditions affect the overall quality of a water body (Giller and Malmqvist, 1998). Additionally, the physical characteristics of a stream affect stream flow, volume of water within the channel, water temperature, and absorbed radiant energy from the sun.

Testing sites are evaluated for: stream depth, width, and current speed; aquatic vegetation; percent substrate and embeddedness; and percent stream canopy cover. Site photos were taken of the upstream and downstream area and are included with the physical and chemical data.

W*ater temperature* directly affects both the nature of aquatic fauna and species diversity; temperature tolerance is organism specific, and the reproductive cycle (including timing of insect emergence and annual productivity) will vary within different temperature ranges. Temperature can also affect organisms indirectly as a consequence of oxygen saturation levels. As water temperature rises, the metabolism of aquatic organisms increases, with an attendant increase in their oxygen requirements. At higher water temperatures, however, the oxygen carrying capacity of water decreases because of a diminished affinity of the water for oxygen. Optimal water temperature ranges and lethal limits of water temperature vary among different organisms. The ratio of Plecoptera to Ephemeroptera (individuals and numbers of species) has been found to drop as the annual range of temperature increases (Hynes, 1970). The optimal temperature range for Brook trout is 11-16 $^0$ Celsius with an upper lethal limit of 24$^0$ Celsius (Hynes, 1970). NYS DEC does not have a water quality standard for water temperature.

Temperature was recorded using a Hydrolab® Quanta™ probe.

*Velocity* was calculated at the time of macroinvertebrate collection because an optimal macroinvertebrate collection site has a velocity between 0.45 and 0.75 meter/second. Velocity was determined using a Global Water® Flow Probe.

### Chemical

*Dissolved Oxygen (DO)* level is a function of water turbulence, diffusion, and plant respiration. The EPA recommends that dissolved oxygen levels remain above 11 mg/l during embryonic and larval stages of salmonid production and above 8 mg/l during other life stages (EPA, 1987). The NYS DEC standard for dissolved oxygen for class C(T) and C(TS) stream is 6 mg/L and 7 mg/L respectively.

A significant drop in DO concentration can occur over a 24-hour period, particularly if a waterbody contains a large amount of plant growth. Oxygen is released into the water as a result of plant photosynthesis during daylight; dense plant growth within a stream can therefore elevate the DO level significantly. At night photosynthesis ceases and DO may drop to levels maintained by diffusion and turbulence. A pre-dawn DO level will, in this case, reflect the lowest DO concentration in a 24 hour period and thus provide important data on the overall health of the system. DO was measured using a Hydrolab® Quanta™ probe.

It is also important to consider *percent oxygen saturation*, since dissolved oxygen levels vary inversely with water temperature. Percent saturation is the maximum level of dissolved oxygen that would be present in the water at a specific temperature in the absence of other influences, and is determined by calculating the ratio of measured dissolved oxygen to maximum dissolved oxygen for a given temperature. (The calculation is also standardized to altitude or barometric pressure.) Percent oxygen saturation falls when something other than temperature, such as dissolved solids or bacterial decomposition, affects oxygen levels.

A healthy stream contains near 100 percent oxygen saturation at any given temperature (Hynes, 1970). Trout are particularly sensitive to even a slight drop in oxygen saturation and will migrate away from streams when oxygen saturation falls. Similarly, certain macroinvertebrates are sensitive to varying saturation levels and because the ability of these organisms to migrate away from the changing conditions is limited a drop in saturation can be lethal. NYS DEC has not adopted percent oxygen saturation as a water quality standard.

*Specific Conductance or Conductivity* is a measure of the ability of an electrical current to pass through a stream; it is dependent on both the concentration of dissolved electrolytes within the water and water temperature. When inorganic ions are dissolved in water, conductivity increases. Organic ions, such as phenols, oil, alcohol and sugar, can decrease conductivity (EPA, 1997). Warmer water is also more conductive and, therefore, conductivity is reported for a standardized water temperature of 25 degrees Celsius. Measurements are reported in microsiemens per centimeter (µS/cm).

In the United States, freshwater stream conductivity readings vary greatly from 50-1,500µS/cm. The conductivity of most streams remains relatively constant, however, unless an extraneous source of contamination is present. A failing septic system would raise conductivity because of its chloride, phosphate, and nitrate content, while an oil spill would lower conductivity.

A Hydrolab® Quanta™ probe was used to measure conductivity.

The *pH* is a measure of a stream's acidity. A desirable pH for salmonid is 6.5-8.5. A Hydrolab® Quanta™ probe used to obtain pH. The NYS DEC standard for pH is 6.5-8.5.

## Biological

Macroinvertebrates are collected by kick net and the specimens are preserved. Pollution-sensitive *macroinvertebrates*, a food source for trout, require similar chemical parameters as trout. The relative numbers of different macroinvertebrate groups indicate the overall health of an ecosystem. Perhaps more importantly, macroinvertebrate data demonstrate the effects of problems that may not be detected by chemical testing.

The NYS DEC Stream Biomonitoring Unit has utilized stream biological monitoring and water quality analysis since 1972 but the biological profiles and water quality assessments are not a part of the state's standards. They serve as a "decision threshold" to determine the need for further studies.

The Environmental Protection Agency recommends that states and tribes with biomonitoring experience adopt biological criteria into water quality standards to provide a quantitative assessment of a waterway's designated and supportive use. Currently only five states have done so; NY is not one of these states.

## Glossary

Anthropogenic: caused by man

Assessment: a diagnosis or evaluation of water quality

Benthic: located on the bottom of a body of water or in the bottom sediments or pertaining to bottom-dwelling organisms

Benthos: organisms occurring on or in the bottom substrate of a waterbody

Biomonitoring: the use of biological indicators to measure water quality

Diel cycle: referring to the 24 hr day

Eutrophic: very enriched with dissolved nutrients, resulting in increased growth of algae and other microscopic plants.

Impact: a change in the physical, chemical, or biological condition of a waterbody

Impairment: a detrimental effect caused by an impact

Index: a number, metric, or parameter derived from sample data used as a measure of water quality

Intolerant: unable to survive poor water quality

Macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats

Mesotrophic: moderately enriched with dissolved nutrients, resulting in increased growth of algae and other microscopic plants.

Non point source: diffuse pollution sources (i.e., without a single point of origin or not introduced into a receiving stream from a specific outlet)

Oligotrophic: few nutrients and relatively few plants and algae.

Periphyton: are algae that grow on a variety of submerged substrates, such as rocks, plants or debris, in lakes or streams

Point source: a stationary location or fixed facility from which pollutants are discharged or emitted. Also, any single identifiable source of pollution, e.g., a pipe, ditch, ship, ore pit, factory smokestack

Rapid bioassessment: a biological diagnosis of water quality using field and laboratory analysis designed to allow assessment of water quality in a short turn-around-time; usually involves kick sampling and laboratory subsampling of the sample

Station: a sampling site on a waterbody

Stenotherms: organisms having a very narrow thermal tolerance and preferring cooler temperatures

Survey: a set of sampling conducted in succession along a stretch of stream

Tolerant: able to survive poor water quality

## References


Bode, R. W., M.A. Novak, and L.E. Abele. 1990. Biological impairment criteria for flowing waters in New York State. NYS DEC technical report.

Bode, R. W., M.A. Novak, and L.E. Abele. 1993. Biological Stream Assessment Lower Esopus Creek. NYS DEC technical report.

Bode, R. W., M.A. Novak, and L.E. Abele. 1996. Biological Stream Assessment Esopus Creek. NYS DEC technical report.

Bode, R. W., M.A. Novak, L.E. Abele, D.L. Heitzman, and A.J. Smith. 2001. Hoosic River Biological Assessment. NYS DEC technical report.

Bode, R. W., M.A. Novak, L.E. Abele, D.L. Heitzman, and A.J. Smith. 2002. Quality Assurance work plan for biological stream monitoring in New York State. NYS DEC technical report.

Bode, R. W., M.A. Novak, L.E. Abele, D.L. Heitzman, and A.J. Smith. 2004. Hoosic River Biological Assessment. NYS DEC technical report.

EPA, Environmental Protection Agency. 1987. Quality Criteria for Water. EPA Publication 440/5-86-001. U.S. Gov. Prin. Office, Washington D.C.

EPA, Environmental Protection Agency. 1997. Volunteer Stream Monitoring: A Methods Manual. Washington D.C.: Office of Wetlands, Oceans and Watersheds, Assessment and Watershed Protection Division (4503F). November.

Giller, Paul S. and Malmqvist, Bjorn. 1998. The Biology of Streams and Rivers. Oxford, New York. Oxford University Press.

Hilsenhoff, William L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist. 20:31-39.

Hynes HBN (1970) The ecology of running waters. University of Toronto Press, Toronto.

Lenat, D.R. 1987. Water quality assessment using a new qualitative collection method for freshwater benthic macroinvertebrates. North Carolina DEM Tech. Report. 12 pp.

Novak, M. A. and Bode, R. W. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. Journal of the North American Benthological Society. 11(1): 80-85.

Plafkin et al. 1999. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers. Washington, D.C.: Office of Water (4503F). July.

Riva-Murry, Karen, Bode, Robert W., Phillips, Patrick J., and Wall, Gretchen L., 2002. Impact Source Determination with Biomonitoring data in New York State: Concordance with Environmental Data. Northeastern Naturalist. Vol., 9. Pp. 127-162.

Simpson, Karl W., Bode, R. W. 1985. Hoosic River Biological Assessment. NYS DEC technical report.

Smith, Alexander J. and Bode, Robert W. 2004. Analysis of variability in New York State benthic macroinvertebrate samples. NYS DEC technical report.

Smith, Alexander J., Bode, Robert W., and Kleppel, Gary S. 2007. A nutrient biotic index (NBI) for use with benthic macroinvertebrate communities. Ecological Indicators. Vol., 7. Pp. 371-386

# APPENDIX

# Nutrient Biotic Index

| Stream | Date | Station | NBI-N | NBI-P |
|---|---|---|---|---|
| **Esopus Creek** | | | | |
| | 7/12/2007 | 01 | 3.63 | 4.47 |
| | 7/12/2007 | 02 | 5.23 | 5.94 |
| | 7/12/2007 | 03 | 5.37 | 5.67 |
| | 7/12/2007 | 04 | 4.99 | 5.79 |
| | 7/12/2007 | 06 | 6.69 | 8.14 |
| | 7/12/2007 | 07A | 4.73 | 6.00 |
| **Sawkill** | | | | |
| | 7/12/2007 | 01 | 4.23 | 5.35 |

# Water Chemistry and Temperature

**Esopus Creek** Ulster Co., NY

| Station | Date | Time | Temp. (C) | SC (umhos) | DO (mg/L) | DO % Sat. | pH | Sal. (PSS) |
|---|---|---|---|---|---|---|---|---|
| 01 | 7/12/2007 | 9:16 AM | 23.02 | 113 | 10.25 | 122.4 | 8.55 | |
| 02 | 7/12/2007 | 10:31 AM | 25.55 | 166 | 9.33 | 113 | 7.75 | 0.08 |
| 03 | 7/12/2007 | 11:23 AM | 24.73 | 172 | 8.48 | 101.4 | 7.38 | 0.08 |
| 04 | 7/12/2007 | 12:03 PM | 23.68 | 195 | 7.05 | 83.3 | 7.36 | 0.09 |
| 06 | 7/12/2007 | 2:21 PM | 25.2 | 296 | 9.17 | 111 | 7.57 | 0.14 |
| 07A | 7/12/2007 | 3:19 PM | 26.45 | 268 | 9.32 | 115.5 | 8.23 | 0.13 |

**Sawkill** Ulster Co., NY

| Station | Date | Time | Temp. (C) | SC (umhos) | DO (mg/L) | DO % Sat. | pH | Sal. (PSS) |
|---|---|---|---|---|---|---|---|---|
| 01 | 7/12/2007 | 1:32 PM | 24.17 | 147 | 9.24 | 109.1 | 8.02 | 0.07 |

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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just above CR 5 bridge** Station: **01**

Municipality: **Marbletown** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **9:16 AM**

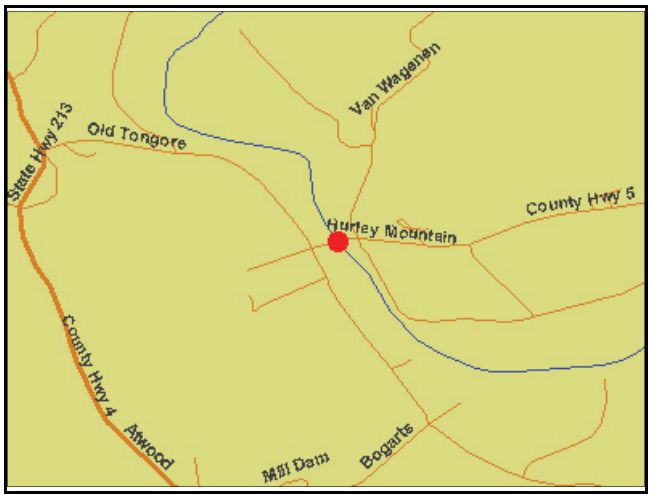
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| <u>Physical Characteristics</u> | |
| Width (meters) | **20** |
| Depth (meters) | **0.15** |
| Current (cm/sec) | **45** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **15** |
| Rubble (6.35 - 25.4 cm) | **20** |
| Gravel (0.2 - 6.35 cm) | **25** |
| Sand (0.06 - 2.0 cm) | **30** |
| Silt (0.004 - 0.06 cm) | **12** |
| Embeddedness (%) | **25** |
| <u>Chemical Measurements</u> | |
| Temperature (C) | **23.02** |
| Specific conductance (umhos) | **113** |
| DO (mg/l) | **10.25** |
| DO % saturation | **122.4** |
| Baro pressure (mm) | **755** |
| pH | **8.55** |
| Salinity (PSS) | |
| <u>Biological Attributes</u> | |
| Canopy (%) | **20** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | **Y** |
| Diatoms | **Y** |
| Macrophytes | |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | **Y** |
| Trichoptera | **Y** |
| Coleoptera | **Y** |
| Megaloptera | **Y** |
| Odonata | |
| Chironomidae | |
| Simuliidae | |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Very good** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 41 52.733

Longitude: -74 08.700

Degree Minutes

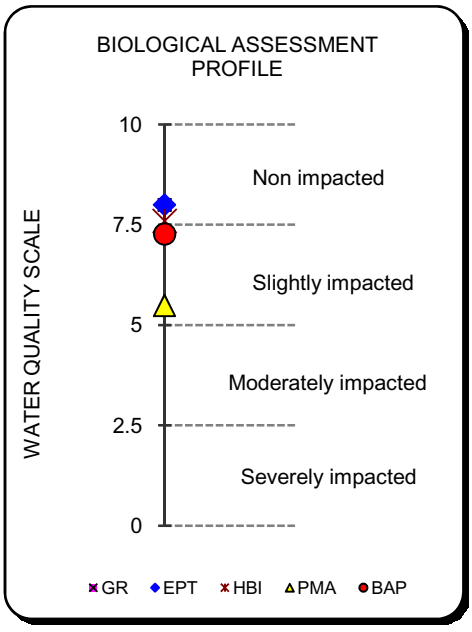
N
W E
S

STREAM SITE: Esopus Creek
LOCATION: Just above CR 5 bridge
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 01
SUBSAMPLE: 100

ARTHROPODA
INSECTA

| | | | |
|---|---|---|---|
| EPHEMEROPTERA | Isonychiidae | Isonychia sp. | 4 |
| | Baetidae | Undetermined Baetidae | 2 |
| | | Acentrella sp. | 2 |
| | | Baetis sp. | 4 |
| | Heptageniidae | Stenonema sp. | 1 |
| | | Undetermined Heptageniidae | 1 |
| PLECOPTERA | Perlidae | Acroneuria sp. | 2 |
| COLEOPTERA | Psephenidae | Psephenus sp. | 5 |
| | Gyrinidae | Dineutus sp. | 3 |
| | Elmidae | Optioservus sp. | 1 |
| | | Stenelmis sp. | 3 |
| MEGALOPTERA | Corydalidae | Corydalus cornutus | 3 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 20 |
| | Hydropsychidae | Cheumatopsyche sp. | 8 |
| | | Hydropsyche sp. | 20 |
| | Hydroptilidae | Hydroptila sp. | 1 |
| DIPTERA | Tipulidae | Undetermined Tipulidae | 1 |
| | Simuliidae | Simulium sp. | 2 |
| | Athericidae | Atherix sp. | 2 |
| | Empididae | Hemerodromia sp. | 9 |
| | Chironomidae | Cardiocladius obscurus | 1 |
| | | Cricotopus bicinctus | 2 |
| | | Polypedilum flavum | 1 |
| | | Rheotanytarsus sp. | 2 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 22
BIOTIC INDEX: 4.4
EPT RICHNESS: 11
MODEL AFFINITY: 52
ASSESSMENT: 7.27 (Slightly impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: 48
NUTRIENT ADDITIONS: **69**
TOXIC: 44
ORGANIC: 36
COMPLEX: 54
SILTATION: 40
IMPOUNDMENT: 60

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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just below Fording Pl. Rd.** Station: **02**

Municipality: **Marbletown** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **10:31 AM**

Field personnel: **J. Kelly Nolan**

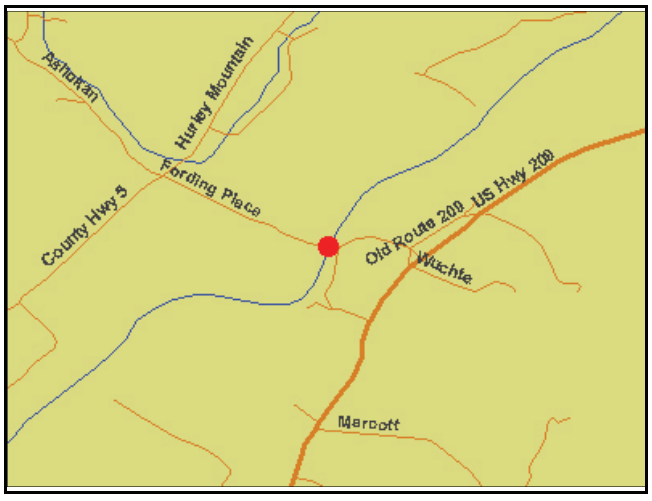
| | |
|---|---|
| <u>Physical Characteristics</u> | |
| Width (meters) | **12** |
| Depth (meters) | **0.2** |
| Current (cm/sec) | **60** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **5** |
| Rubble (6.35 - 25.4 cm) | **45** |
| Gravel (0.2 - 6.35 cm) | **30** |
| Sand (0.06 - 2.0 cm) | **10** |
| Silt (0.004 - 0.06 cm) | **10** |
| Embeddedness (%) | **30** |
| <u>Chemical Measurements</u> | |
| Temperature (C) | **25.55** |
| Specific conductance (umhos) | **166** |
| DO (mg/l) | **9.33** |
| DO % saturation | **113** |
| Baro pressure (mm) | **755** |
| pH | **7.75** |
| Salinity (PSS) | **0.08** |
| <u>Biological Attributes</u> | |
| Canopy (%) | **25** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | |
| Diatoms | **Y** |
| Macrophytes | **Y** |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | |
| Trichoptera | **Y** |
| Coleoptera | **Y** |
| Megaloptera | **Y** |
| Odonata | |
| Chironomidae | **Y** |
| Simuliidae | **Y** |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Good** |

Notes/observations:

Trucks crossing stream bed.

Flow

Flow




Scale: 1 mile

Latitude: 41 53.030

Longitude: -74 07.040

Degree Minutes

N
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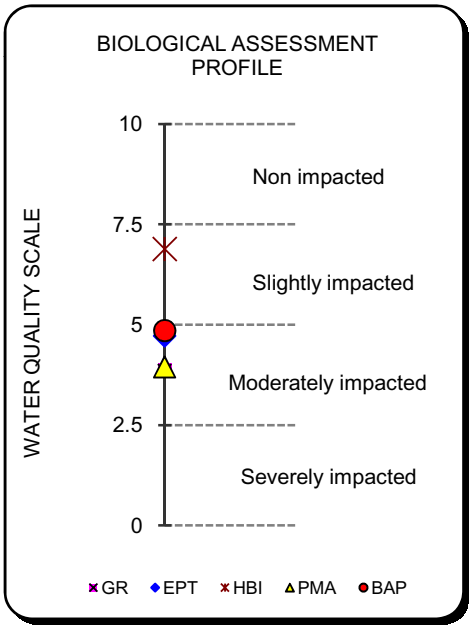
S

STREAM SITE: Esopus Creek
LOCATION: Just below Fording Pl. Rd.
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 02
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| ARTHROPODA | | | |
| INSECTA | | | |
| EPHEMEROPTERA | Heptageniidae | Undetermined Heptageniidae | 2 |
| COLEOPTERA | Elmidae | Optioservus sp. | 1 |
| | | Stenelmis sp. | 1 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 2 |
| | Hydropsychidae | Cheumatopsyche sp. | 11 |
| | | Hydropsyche sp. | 23 |
| | Leptoceridae | Oecetis sp. | 1 |
| DIPTERA | Simuliidae | Simulium sp. | 30 |
| | Empididae | Hemerodromia sp. | 10 |
| | Chironomidae | Thienemannimyia gr. spp. | 1 |
| | | Cricotopus sp. | 1 |
| | | Tvetenia sp. | 3 |
| | | Dicrotendipes neomodestus | 1 |
| | | Rheotanytarsus sp. | 13 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 14
BIOTIC INDEX: 4.99
EPT RICHNESS: 5
MODEL AFFINITY: 43
ASSESSMENT: 4.86 (Moderately impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: 38
NUTRIENT ADDITIONS: **48**
TOXIC: 36
ORGANIC: 47
COMPLEX: 45
SILTATION: 47
IMPOUNDMENT: **53**

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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just off Creek Side Rd.** Station: **03**

Municipality: **Marbletown** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **11:23 AM**

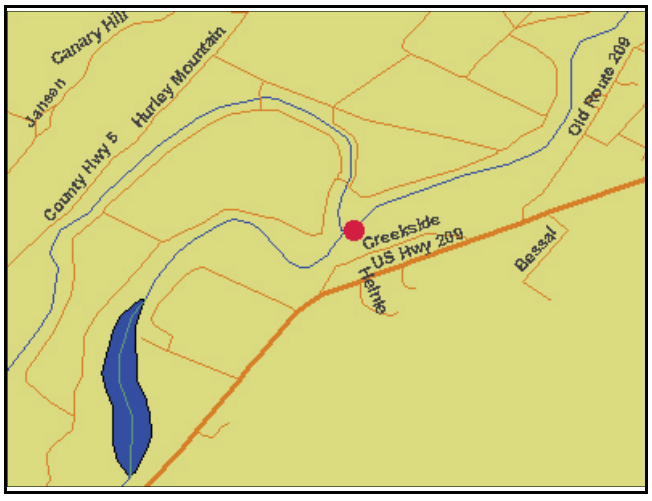
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| Physical Characteristics | |
| Width (meters) | **14** |
| Depth (meters) | **0.3** |
| Current (cm/sec) | **60** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **30** |
| Rubble (6.35 - 25.4 cm) | **35** |
| Gravel (0.2 - 6.35 cm) | **25** |
| Sand (0.06 - 2.0 cm) | **15** |
| Silt (0.004 - 0.06 cm) | **5** |
| Embeddedness (%) | **25** |
| Chemical Measurements | |
| Temperature (C) | **24.73** |
| Specific conductance (umhos) | **172** |
| DO (mg/l) | **8.48** |
| DO % saturation | **101.4** |
| Baro pressure (mm) | **757** |
| pH | **7.38** |
| Salinity (PSS) | **0.08** |
| Biological Attributes | |
| Canopy (%) | **35** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | **Y** |
| Diatoms | **Y** |
| Macrophytes | **Y** |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | |
| Trichoptera | **Y** |
| Coleoptera | **Y** |
| Megaloptera | |
| Odonata | **Y** |
| Chironomidae | **Y** |
| Simuliidae | **N** |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Good** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 41 54.334

Longitude: -74 05.451

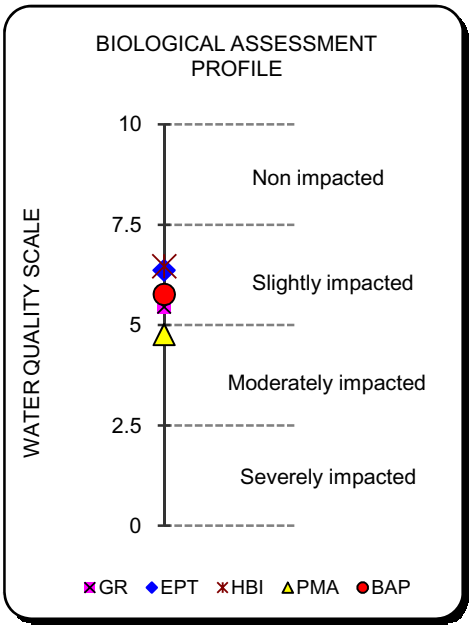
Degree Minutes

N
W
E
S

STREAM SITE: Esopus Creek
LOCATION: Just off Creek Side Rd.
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 03
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| MOLLUSCA | | | |
| PELECYPODA | | | |
| | Sphaeriidae | Undetermined Sphaeriidae | 1 |
| ARTHROPODA | | | |
| CRUSTACEA | | | |
| AMPHIPODA | Gammaridae | Gammarus sp. | 1 |
| INSECTA | | | |
| EPHEMEROPTERA | Isonychiidae | Isonychia sp. | 2 |
| | Baetidae | Undetermined Baetidae | 3 |
| | Heptageniidae | Undetermined Heptageniidae | 1 |
| | | Stenonema sp. | 1 |
| COLEOPTERA | Gyrinidae | Dineutus sp. | 1 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 4 |
| | Hydropsychidae | Cheumatopsyche sp. | 20 |
| | | Hydropsyche sp. | 9 |
| | | Undetermined Hydropsychidae | 1 |
| DIPTERA | Simuliidae | Simulium sp. | 5 |
| | Empididae | Hemerodromia sp. | 13 |
| | Chironomidae | Cricotopus bicinctus | 1 |
| | | Cricotopus sp. | 2 |
| | | Polypedilum aviceps | 1 |
| | | Polypedilum flavum | 3 |
| | | Rheotanytarsus sp. | 29 |
| | | Tanytarsus sp. | 2 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 17
BIOTIC INDEX: 5.33
EPT RICHNESS: 8
MODEL AFFINITY: 48
ASSESSMENT: 5.76 (Slightly impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: 49
NUTRIENT ADDITIONS: **50**
TOXIC: 34
ORGANIC: 45
COMPLEX: 45
SILTATION: 48
IMPOUNDMENT: **52**

Watershed Assessment Associates
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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just below Winkoop Rd. bridge** Station: **04**

Municipality: **Hurley** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **12:03 PM**

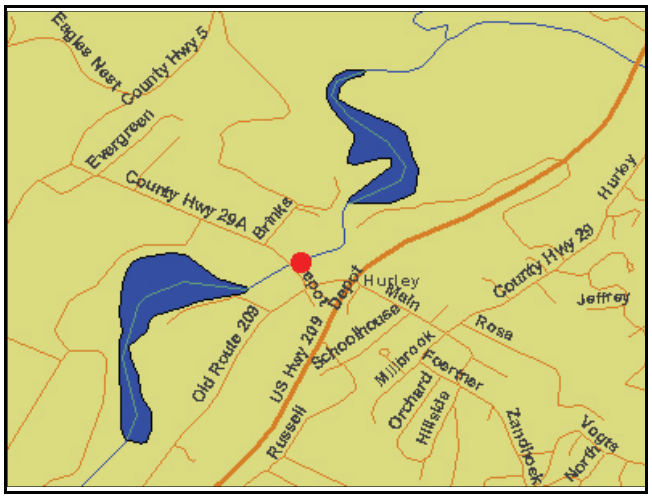
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| Physical Characteristics | |
| Width (meters) | **14** |
| Depth (meters) | **0.15** |
| Current (cm/sec) | **70** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **5** |
| Rubble (6.35 - 25.4 cm) | **20** |
| Gravel (0.2 - 6.35 cm) | **40** |
| Sand (0.06 - 2.0 cm) | **30** |
| Silt (0.004 - 0.06 cm) | **5** |
| Embeddedness (%) | **30** |
| Chemical Measurements | |
| Temperature (C) | **23.68** |
| Specific conductance (umhos) | **195** |
| DO (mg/l) | **7.05** |
| DO % saturation | **83.3** |
| Baro pressure (mm) | **757** |
| pH | **7.36** |
| Salinity (PSS) | **0.09** |
| Biological Attributes | |
| Canopy (%) | **40** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | **Y** |
| Diatoms | **Y** |
| Macrophytes | |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | |
| Trichoptera | **Y** |
| Coleoptera | |
| Megaloptera | |
| Odonata | |
| Chironomidae | **Y** |
| Simuliidae | **Y** |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Good** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 41 55.733

Longitude: -74 03.967

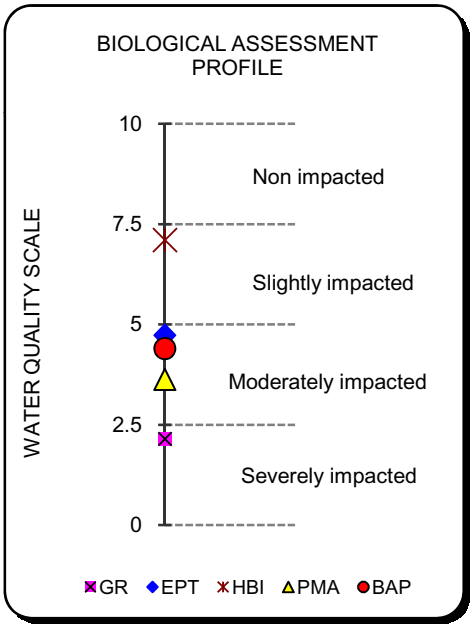
Degree Minutes

N
W E
S

STREAM SITE: Esopus Creek
LOCATION: Just below Winkoop Rd. bridge
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 04
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| ARTHROPODA | | | |
| INSECTA | | | |
| EPHEMEROPTERA | Heptageniidae | Undetermined Heptageniidae | 1 |
| | | Stenonema sp. | 1 |
| COLEOPTERA | Elmidae | Stenelmis sp. | 1 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 2 |
| | Hydropsychidae | Cheumatopsyche sp. | 7 |
| | | Hydropsyche sp. | 35 |
| DIPTERA | Simuliidae | Simulium sp. | 28 |
| | Empididae | Hemerodromia sp. | 7 |
| | Chironomidae | Cardiocladius obscurus | 1 |
| | | Tvetenia sp. | 1 |
| | | Polypedilum flavum | 1 |
| | | Rheotanytarsus sp. | 15 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 11
BIOTIC INDEX: 4.82
EPT RICHNESS: 5
MODEL AFFINITY: 41
ASSESSMENT: 4.4 (Moderately impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: 35
NUTRIENT ADDITIONS: **55**
TOXIC: 35
ORGANIC: **55**
COMPLEX: **53**
SILTATION: 44
IMPOUNDMENT: **58**

Watershed Assessment Associates
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# Field Data Summary

Stream name: **Sawkill** Watershed: **Hudson** ID: **SAWK**

Location: **Just below Sawkill Rd bridge** Station: **01**

Municipality: **Ulster** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **1:32 PM**

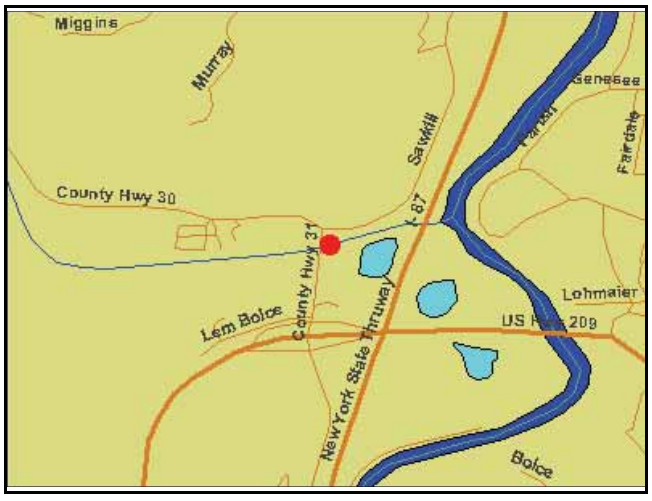
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| Physical Characteristics | |
| Width (meters) | **14** |
| Depth (meters) | **0.2** |
| Current (cm/sec) | **100** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **10** |
| Rubble (6.35 - 25.4 cm) | **40** |
| Gravel (0.2 - 6.35 cm) | **30** |
| Sand (0.06 - 2.0 cm) | **15** |
| Silt (0.004 - 0.06 cm) | **5** |
| Embeddedness (%) | **25** |
| Chemical Measurements | |
| Temperature (C) | **24.17** |
| Specific conductance (umhos) | **147** |
| DO (mg/l) | **9.24** |
| DO % saturation | **109.1** |
| Baro pressure (mm) | **757** |
| pH | **8.02** |
| Salinity (PSS) | **0.07** |
| Biological Attributes | |
| Canopy (%) | **25** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | |
| Diatoms | **Y** |
| Macrophytes | |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | **Y** |
| Trichoptera | **Y** |
| Coleoptera | **Y** |
| Megaloptera | **Y** |
| Odonata | |
| Chironomidae | **Y** |
| Simuliidae | |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Very good** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 41 58.783

Longitude: -74 00.817

Degree Minutes

Watershed Assessment Associates
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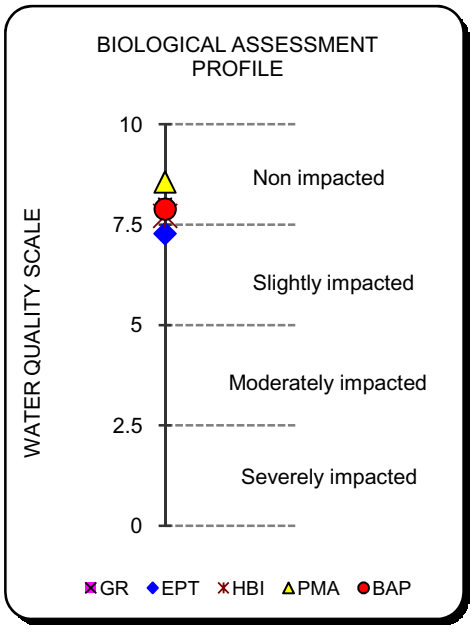
STREAM SITE: Sawkill
LOCATION: Just below Sawkill Rd bridge
DATE: 12 July 2007 ID: SAWK
SAMPLE TYPE: Kick sample Station: 01
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| ARTHROPODA | | | |
| INSECTA | | | |
| EPHEMEROPTERA | Isonychiidae | Isonychia sp. | 11 |
| | Baetidae | Baetis sp. | 16 |
| | Heptageniidae | Stenonema sp. | 5 |
| | Ephemerellidae | Ephemerella sp. | 2 |
| | Caenidae | Caenis sp. | 2 |
| PLECOPTERA | Perlidae | Acroneuria sp. | 3 |
| ODONATA | Coenagrionidae | Undetermined Coenagrionidae | 1 |
| COLEOPTERA | Psephenidae | Psephenus herricki | 3 |
| | Elmidae | Optioservus sp. | 3 |
| | | Stenelmis sp. | 9 |
| MEGALOPTERA | Corydalidae | Corydalus cornutus | 1 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 11 |
| | Hydropsychidae | Cheumatopsyche sp. | 6 |
| | | Hydropsyche sp. | 11 |
| | Uenoidae | Neophylax sp. | 2 |
| DIPTERA | Tipulidae | Antocha sp. | 1 |
| | Simuliidae | Simulium sp. | 4 |
| | Chironomidae | Cricotopus bicinctus | 1 |
| | | Eukiefferiella sp. | 1 |
| | | Microtendipes pedellus gr. | 2 |
| | | Polypedilum flavum | 2 |
| | | Rheotanytarsus sp. | 3 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 22
BIOTIC INDEX: 4.28
EPT RICHNESS: 10
MODEL AFFINITY: 75
ASSESSMENT: 7.9 (Non impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: **66**
NUTRIENT ADDITIONS: 57
TOXIC: 54
ORGANIC: 41
COMPLEX: 46
SILTATION: 48
IMPOUNDMENT: 59

Watershed Assessment Associates
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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just below CR 41 bridge** Station: **06**

Municipality: **Ulster** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **2:21 PM**

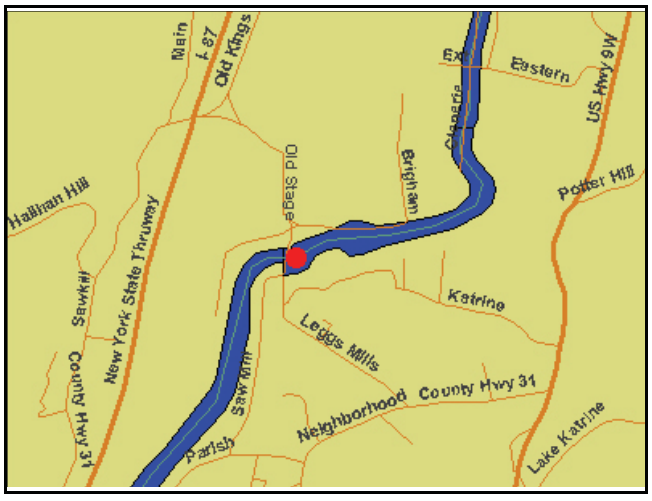
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| Physical Characteristics | |
| Width (meters) | **80** |
| Depth (meters) | **0.2** |
| Current (cm/sec) | **125** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **95** |
| Rubble (6.35 - 25.4 cm) | **5** |
| Gravel (0.2 - 6.35 cm) | |
| Sand (0.06 - 2.0 cm) | |
| Silt (0.004 - 0.06 cm) | |
| Embeddedness (%) | |
| Chemical Measurements | |
| Temperature (C) | **25.2** |
| Specific conductance (umhos) | **296** |
| DO (mg/l) | **9.17** |
| DO % saturation | **111** |
| Baro pressure (mm) | **757** |
| pH | **7.57** |
| Salinity (PSS) | **0.14** |
| Biological Attributes | |
| Canopy (%) | **10** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | **Y** |
| Diatoms | **Y** |
| Macrophytes | |
| Occurance of macroinvertebrates | |
| Ephemeroptera | |
| Plecoptera | |
| Trichoptera | **Y** |
| Coleoptera | |
| Megaloptera | |
| Odonata | |
| Chironomidae | **Y** |
| Simuliidae | **Y** |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Poor** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 41 59.700

Longitude: -73 59.867

Degree Minutes

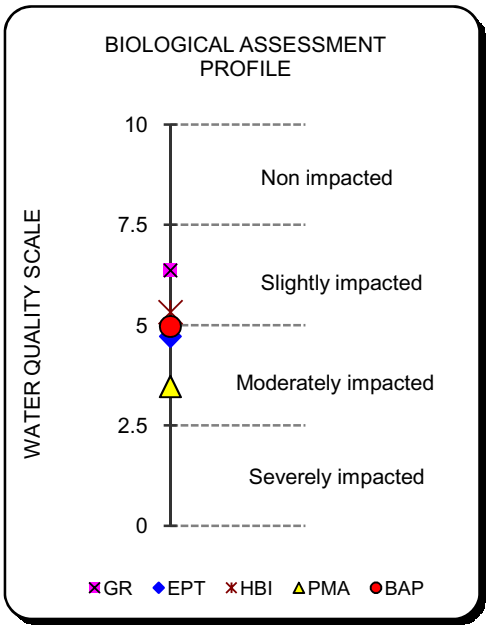
N W E S

Watershed Assessment Associates
Environmental Services / Biomonitoring / Invertebrate Taxonomy / Professional Training

STREAM SITE: Esopus Creek
LOCATION: Just below CR 41 bridge
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 06
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| MOLLUSCA | | | |
| GASTROPODA | | | |
| | Physidae | Undetermined Physidae | 1 |
| ARTHROPODA | | | |
| CRUSTACEA | | | |
| AMPHIPODA | Talitridae | Hyalella azteca | 1 |
| INSECTA | | | |
| EPHEMEROPTERA | Baetidae | Undetermined Baetidae | 1 |
| MEGALOPTERA | Corydalidae | Chauliodes sp. | 1 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 1 |
| | Hydropsychidae | Cheumatopsyche sp. | 3 |
| | | Hydropsyche sp. | 2 |
| | Hydroptilidae | Hydroptila sp. | 3 |
| DIPTERA | Simuliidae | Simulium sp. | 14 |
| | Chironomidae | Cardiocladius obscurus | 2 |
| | | Cricotopus bicinctus | 3 |
| | | Cricotopus tremulus gr. | 8 |
| | | Cricotopus sp. | 15 |
| | | Eukiefferiella sp. | 3 |
| | | Dicrotendipes sp. | 3 |
| | | Parachironomus frequens | 1 |
| | | Polypedilum flavum | 17 |
| | | Polypedilum illinoense | 17 |
| | | Tanytarsus sp. | 3 |
| | | Rheotanytarsus sp. | 1 |

BIOLOGICAL ASSESSMENT PROFILE (BAP)
GENERA RICHNESS: 19
BIOTIC INDEX: 6.24
EPT RICHNESS: 5
MODEL AFFINITY: 40
ASSESSMENT: 4.97 (Moderately impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: 30
NUTRIENT ADDITIONS: **47**
TOXIC: 34
ORGANIC: 40
COMPLEX: **45**
SILTATION: **48**
IMPOUNDMENT: 37

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# Field Data Summary

Stream name: **Esopus Creek** Watershed: **Hudson** ID: **ESOP**

Location: **Just below Glasco Tpke Rd. bridge** Station: **07A**

Municipality: **Saugerties** **Ulster Co., NY**

Date sampled: **Thursday, July 12, 2007**

Arrival time at station: **3:19 PM**

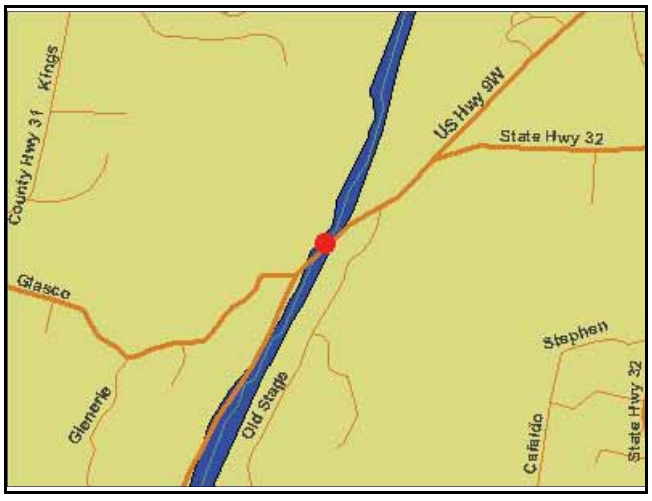
Field personnel: **J. Kelly Nolan**

| | |
|---|---|
| Physical Characteristics | |
| Width (meters) | **90** |
| Depth (meters) | **0.3** |
| Current (cm/sec) | **50** |
| Substrate (%) | |
| Rock (>25.4 cm or bedrock) | **35** |
| Rubble (6.35 - 25.4 cm) | **25** |
| Gravel (0.2 - 6.35 cm) | **20** |
| Sand (0.06 - 2.0 cm) | **10** |
| Silt (0.004 - 0.06 cm) | **10** |
| Embeddedness (%) | **25** |
| Chemical Measurements | |
| Temperature (C) | **26.45** |
| Specific conductance (umhos) | **268** |
| DO (mg/l) | **9.32** |
| DO % saturation | **115.5** |
| Baro pressure (mm) | **760** |
| pH | **8.23** |
| Salinity (PSS) | **0.13** |
| Biological Attributes | |
| Canopy (%) | **10** |
| Aquatic vegetation | |
| Algae suspended | |
| Algae filamentous | **Y** |
| Diatoms | **Y** |
| Macrophytes | |
| Occurance of macroinvertebrates | |
| Ephemeroptera | **Y** |
| Plecoptera | **Y** |
| Trichoptera | **Y** |
| Coleoptera | |
| Megaloptera | |
| Odonata | |
| Chironomidae | **Y** |
| Simuliidae | **Y** |
| Decapoda | |
| Gammaridae | |
| Mollusca | |
| Oligochaeta | |
| Other macroinvertebrates | |
| Field faunal condition | **Very good** |

Notes/observations:

Flow

Flow




Scale: 1 mile

Latitude: 42 01.817

Longitude: -73 58.550

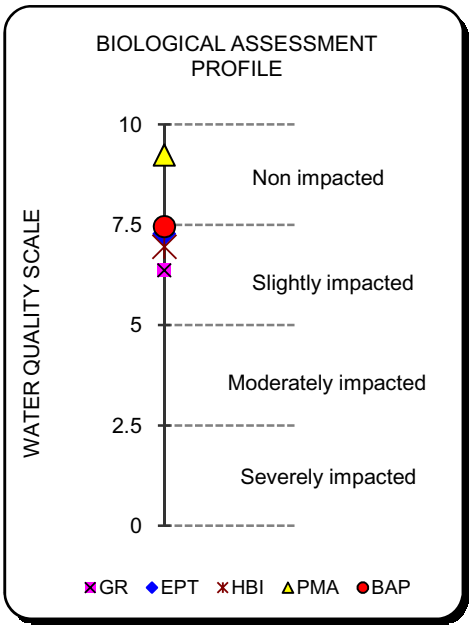
Degree Minutes

N
W E
S

STREAM SITE: Esopus Creek
LOCATION: Just below Glasco Tpke Rd. bridge
DATE: 12 July 2007 ID: ESOP
SAMPLE TYPE: Kick sample Station: 07A
SUBSAMPLE: 100

| | | | |
|---|---|---|---|
| ARTHROPODA | | | |
| INSECTA | | | |
| EPHEMEROPTERA | Isonychiidae | Isonychia sp. | 5 |
| | Baetidae | Baetis sp. | 19 |
| | Heptageniidae | Stenonema sp. | 5 |
| | Ephemerellidae | Undetermined Ephemerellidae | 1 |
| | Caenidae | Caenis sp. | 1 |
| PLECOPTERA | Perlidae | Perlesta sp. | 1 |
| LEPIDOPTERA | | Undetermined Lepidoptera | 3 |
| COLEOPTERA | Elmidae | Stenelmis sp. | 10 |
| TRICHOPTERA | Philopotamidae | Chimarra sp. | 5 |
| | Hydropsychidae | Cheumatopsyche sp. | 9 |
| | | Hydropsyche sp. | 4 |
| | | Macrostemum sp. | 4 |
| DIPTERA | Tipulidae | Antocha sp. | 2 |
| | Simuliidae | Simulium sp. | 6 |
| | Chironomidae | Tvetenia sp. | 1 |
| | | Microtendipes pedellus gr. | 5 |
| | | Polypedilum flavum | 6 |
| | | Rheotanytarsus sp. | 12 |
| | | Tanytarsus sp. | 1 |

GENERA RICHNESS: 19
BIOTIC INDEX: 4.94
EPT RICHNESS: 10
MODEL AFFINITY: 82
ASSESSMENT: 7.45 (Slightly impacted)




IMPACT SOURCE DETERMINATION (ISD)
NATURAL: **67**
NUTRIENT ADDITIONS: **69**
TOXIC: 53
ORGANIC: 52
COMPLEX: 43
SILTATION: 58
IMPOUNDMENT: 58

# TOTAL TAXA LIST

Esopus Creek Ulster Co., NY July 12, 2007

| ORDER | FAMILY | GENUS/SPECIES |
|---|---|---|
| AMPHIPODA | Gammaridae | *Gammarus sp.* |
| | Talitridae | *Hyalella azteca* |
| COLEOPTERA | Elmidae | *Optioservus sp.* |
| | | *Stenelmis sp.* |
| | Gyrinidae | *Dineutus sp.* |
| | Psephenidae | *Psephenus herricki* |
| | | *Psephenus sp.* |
| DIPTERA | Athericidae | *Atherix sp.* |
| | Chironomidae | *Cardiocladius obscurus* |
| | | *Cricotopus bicinctus* |
| | | *Cricotopus sp.* |
| | | *Cricotopus tremulus gr.* |
| | | *Dicrotendipes neomodestus* |
| | | *Dicrotendipes sp.* |
| | | *Eukiefferiella sp.* |
| | | *Microtendipes pedellus gr.* |
| | | *Parachironomus frequens* |
| | | *Polypedilum aviceps* |
| | | *Polypedilum flavum* |
| | | *Polypedilum illinoense* |
| | | *Rheotanytarsus sp.* |
| | | *Tanytarsus sp.* |
| | | *Thienemannimyia gr. spp.* |
| | | *Tvetenia sp.* |
| | Empididae | *Hemerodromia sp.* |
| | Simuliidae | *Simulium sp.* |
| | Tipulidae | *Antocha sp.* |
| | | *Tipulidae* |
| EPHEMEROPTERA | Baetidae | *Acentrella sp.* |
| | | *Baetidae* |
| | | *Baetis sp.* |
| | Caenidae | *Caenis sp.* |
| | Ephemerellidae | *Ephemerella sp.* |
| | | *Ephemerellidae* |
| | Heptageniidae | *Heptageniidae* |
| | | *Stenonema sp.* |
| | Isonychiidae | *Isonychia sp.* |

## TOTAL TAXA LIST Esopus Creek Ulster Co., NY July 12, 2007

| ORDER | FAMILY | GENUS/SPECIES |
|---|---|---|
| LEPIDOPTERA | | *Lepidoptera* |
| MEGALOPTERA | Corydalidae | *Chauliodes sp.* |
| | | *Corydalus cornutus* |
| ODONATA | Coenagrionidae | *Coenagrionidae* |
| PLECOPTERA | Perlidae | *Acroneuria sp.* |
| | | *Perlesta sp.* |
| TRICHOPTERA | Hydropsychidae | *Cheumatopsyche sp.* |
| | | *Hydropsyche sp.* |
| | | *Hydropsychidae* |
| | | *Macrostemum sp.* |
| | Hydroptilidae | *Hydroptila sp.* |
| | Leptoceridae | *Oecetis sp.* |
| | Philopotamidae | *Chimarra sp.* |
| | Uenoidae | *Neophylax sp.* |
| | Physidae | *Physidae* |
| | Sphaeriidae | *Sphaeriidae* |