HOOSIC RIVER 2007 BIOASSESSMENT
HOOSICK FALLS, NY

HOOSIC RIVER WATERSHED ASSOCIATION
WATER QUALITY MONITORING PROGRAM

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Survey date: July 18, 2007

Report date: February 3, 2008

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The cover photo is of a stonefly nymph collected at station 07.

Thanks to Lotic Scene Investigation (LSI) students Joanne Passias and Corrinn Shogry from Massachusetts College of Liberal Arts for their assistance on this study.

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Summary

The Hoosic River Watershed Association (HooRWA) performed a follow-up water quality survey in 2007 on the Hoosic River to determine if biological impairment found in 2006 around the Oak Mitsui research facility in Hoosic Falls, NY, had persisted. The 2006 study showed deterioration in the macroinvertebrate community structure similar to that documented by the NYS DEC after copper sulfate spills from the Oak Mitsui facility in 1983 and 2001. The DEC documented subsequent recovery of the water in 2004.

Physical, chemical and biological parameters tested in 2007 showed that water quality had improved at a station that showed changes in 2006 similar to those found after copper sulfate spills in 1983 and 2001. Impacted water was found at two sites, but the nature of the test results indicate that this impact is probably secondary to nutrient additions and not related to any suspected spillage.

Background

The Hoosic River travels approximately 70 miles from its source at the Cheshire Reservoir in Massachusetts, through Vermont and New York before entering the Hudson River at Stillwater, NY. The watershed encompasses 720 square miles and includes land used for commercial, industrial, agricultural, and residential purposes. The river is popular for boating, fishing, and swimming. Major threats to the Hoosic's water quality are point and non-point source inputs, siltation, industrial discharges, and stream habitat alterations.

In this study, 3 stations were sampled following the NYS DEC Stream Biomonitoring Unit *Quality Assurance Work Plan for Biological Stream Monitoring* and *Biological Impairment Criteria for Flowing Waters in NYS* (Bode et al., 1990 and 2002).

(HooRWA also collected data at five other stations on the Hoosic River and its tributaries in Massachusetts, the results of which will be included in a separate report.)

See figure II for a map of the station locations.

Methods

Stations assessed in this study have been previously assessed by the NYS DEC and the Hoosic River Watershed Association. 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.

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 (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.

Three replicate macroinvertebrate samples were collected at each site within the same riffle section 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). Each replicate sample was separately preserved in 95% ethyl alcohol. Replicate samples were then sub-sampled in the lab by randomly selecting a tablespoon 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 replicate sample. Macroinvertebrates were identified to genus/species level to determine the water quality category for each site and determine the Impact Source Determination (ISD) described by Riva-Murry et al. (2002).

Each site's replicates were compared to each other, at the ordinal level, to assess sampling technique and variability.

In addition to categorizing water quality for each site, a statistical comparison of the replicate samples between sites was performed to determine if any significant biological difference was evident. Biological impairment is determined by collecting samples at each site that meet the physical and biological similarity requirements for replicate samples, then calculating the differences between these samples and replicate samples at other sites (Bode 1990). Biological impairment is present if the comparison (usually of an "above discharge" site to a "below discharge" site) is statistically different using the student t-test ($P = .05$).

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 100 percent accurate in categorizing water quality in the NYS DEC four-tiered method of assessment (J. Kelly Nolan, unpublished data).

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

Table I.

Multi metrics used to determine the Biological Assessment Profile	
Genera Richness (GR)	The total number of taxa found in the sub-sample. Higher richness values are mostly associated with clean water conditions.
EPT Richness (EPT)	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)	The Hilsenhoff Biotic Index -- 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)	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)	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 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). See table II.

Table II.

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. For further explanation see appendix.

The appendix contains the macroinvertebrate taxa list, BAP and ISD results for each station.

Results

The Biological Assessment Profile (BAP) score ranged from non-impacted to slightly impacted water quality (see graph I). Impact Source Determination indicated that impact at stations 07 and 08 are primarily from non point source nutrient additions. The ISD at station 09 indicated a combination nutrients, toxic, sewage, or municipal/industrial, or a combination of these. See appendix.

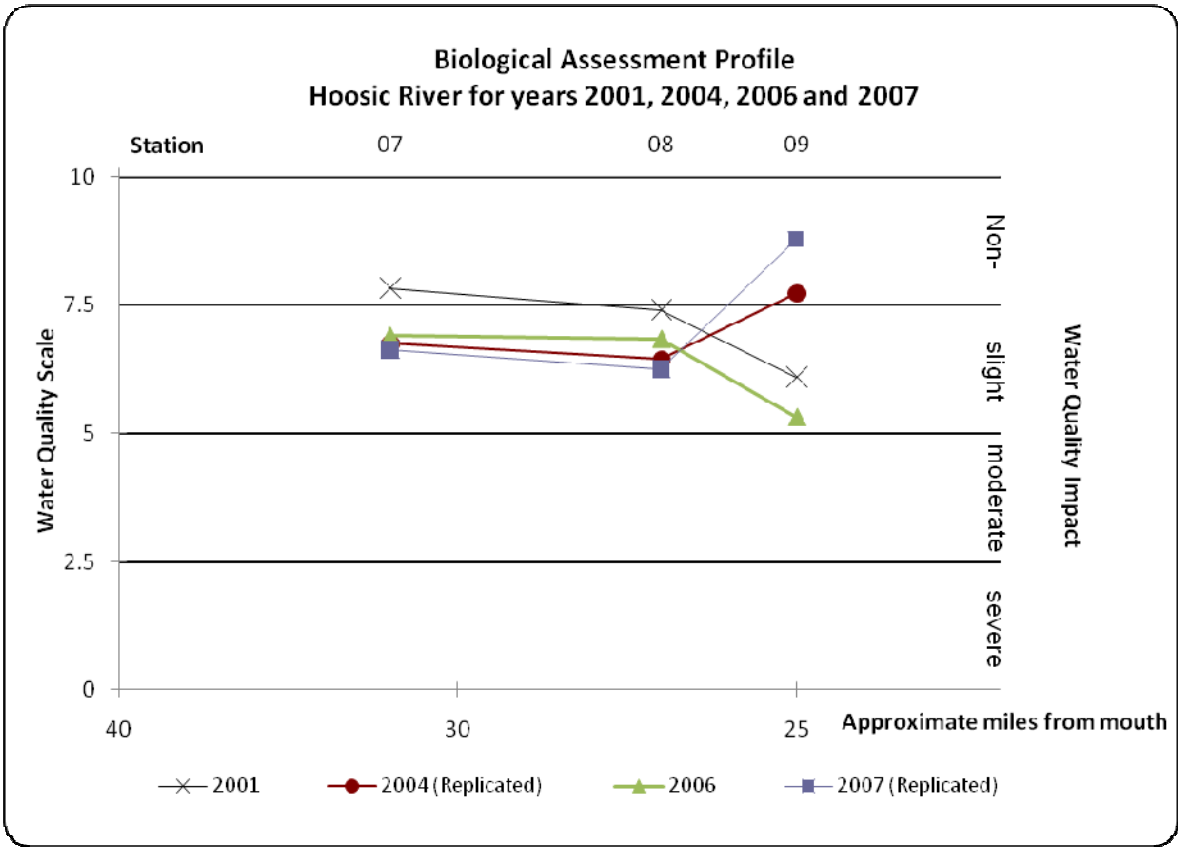
The dissolved oxygen concentration ranged from 7 to 8.27mg/l, and dissolved oxygen percent saturation ranged from 78.4 to 92.3%. Water temperature ranged from 20.86 to 21.56 degrees Celsius; specific conductance ranged from 260 to 277µmhos/cm; and pH ranged from 7.31 to 7.85. See appendix for a chemical summary chart.

Similarity between replicates at each site was 75 percent or higher.

The student t-test results between stations 07 and 08 (above and below the Oak Mitsui discharge) are not statistically different. There were statistically significant differences between 08 and 09 for taxa richness, between 07 and 09 for Biotic Index, between 08 and 09 for EPT Richness and between both stations 07 / 08 and 09 for PMA (see table III for metric results). The range of student t-test results are: paired $t(2) = 4.07 – 14.91$, $p = 0.004 – 0.043$. Interestingly, the data demonstrates improvement in water quality at the downstream station (09) compared to the upstream stations (07 and 08).

Table III

Station/Rep	Taxa Richness	Biotic Index	EPT Richness	Model Affinity	BAP
07 A	22	4.58	10	53	7.1
07 D	17	4.73	8	46	5.87
07 C	20	4.78	11	53	6.9
Mean	**20**	**4.70**	**10**	**51**	**6.62**
08 A	12	4.45	7	41	5.01
08 B	21	4.45	12	49	7.06
08 D	19	4.45	9	55	6.67
Mean	**17**	**4.45**	**9**	**48**	**6.25**
09 A	25	4.29	12	75	8.56
09 C	29	4.38	15	70	8.9
09 D	29	4.28	14	72	8.9
Mean	**28**	**4.32**	**14**	**72**	**8.79**



Graph I. 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 scores of each station on the Hoosic River. The 2001 and 2004 assessments were conducted by the NYS DEC and the 2006 and 2007 assessments were conducted by HooRWA. A copper sulfate spill occurred prior to the NYS DEC 2001 assessment; the results reflect the affect of the spill.

Discussion

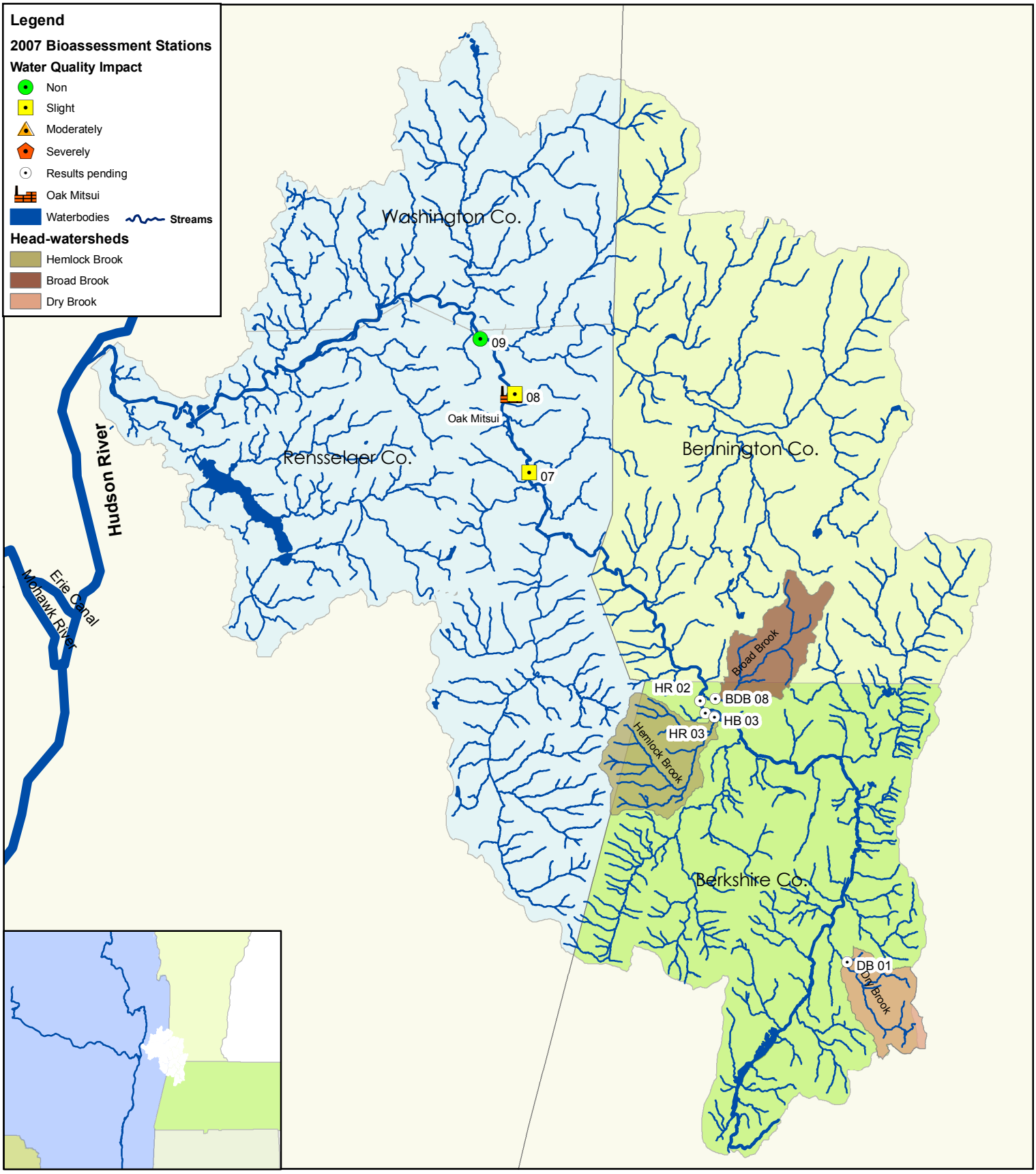
In this survey, water quality of the Hoosic River improved at a station that demonstrated changes in 2006 similar to those found after copper sulfate spills in 1983 and 2001. There is no actual documentation that a copper sulfate spill occurred in 2006, but interestingly, the DEC reported after the previous spills that they expected the effect of the impact would mitigate over 12 months; such an improvement occurred between the 2006 and current surveys.

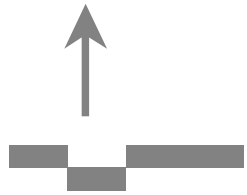
Prior surveys of the Hoosic have demonstrated that non point source nutrients are adversely affecting its water quality. Although water quality at stations 07 and 08 has been consistent for the past several years, it has declined noticeably at these sites since 2001. The most likely cause of this decline, according to ISD, is from non point source nutrients.

Interestingly, there is actually an improvement in water quality at the downstream station 09 compared to stations 07 and 08. The Walloomsac River enters the Hoosic just above station 09, and is probably mitigating the effect of nutrient impacts affecting the more

upstream water. (At the time of the copper spills, however, station 09 showed significant impact, indicating that the Walloomsac flow did not mitigate the effect of the spills). This study demonstrates that the Hoosic is capable of exhibiting non-impacted water quality, but that stations 07 and 08 are biologically impaired. Addressing the effect of nutrient impacts on the stream will improve its overall water quality.

APPENDIX





Hoosic River Watershed Association

2007 Water Quality Monitoring Project

Figure 1

Hoosic River Watershed

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.

Water 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 240 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.

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

Water Chemistry and Temperature

Broad Brook

Station	*Date*	*Time*	*Temp. (C)*	*SC (umhos)*	*DO (mg/L)*	*DO % Sat.*	*pH*	*Sal. (PSS)*
BDB 08	8/9/2007	10:00 AM	17.39	154	9.28	97.9	7.8	0.07

Dry Brook

Station	*Date*	*Time*	*Temp. (C)*	*SC (umhos)*	*DO (mg/L)*	*DO % Sat.*	*pH*	*Sal. (PSS)*
DB 01	8/9/2007	11:00 AM	18.78	234	8.73	96.6	7.85	0.11

Hemlock Brook

Station	*Date*	*Time*	*Temp. (C)*	*SC (umhos)*	*DO (mg/L)*	*DO % Sat.*	*pH*	*Sal. (PSS)*
HB 03	8/9/2007	9:30 AM	17.5	304	9.06	96.2	7.88	0.14

Hoosic River

Station	*Date*	*Time*	*Temp. (C)*	*SC (umhos)*	*DO (mg/L)*	*DO % Sat.*	*pH*	*Sal. (PSS)*
07	7/18/2007	8:17 AM	20.86	277	7	78.4	7.31	0.13
08	7/18/2007	9:37 AM	21.38	268	8.06	90.4	7.73	0.13
09	7/18/2007	10:46 AM	21.56	260	8.27	92.3	7.85	0.12

Field Data Summary

Stream name: **Hoosic River** Watershed: **Hoosic** ID: **HOOS**

Location: **400 meters below Rt. 7 bridge** Station: **07**

Municipality: **Hoosick Falls** **Rensselaer Co., NY**

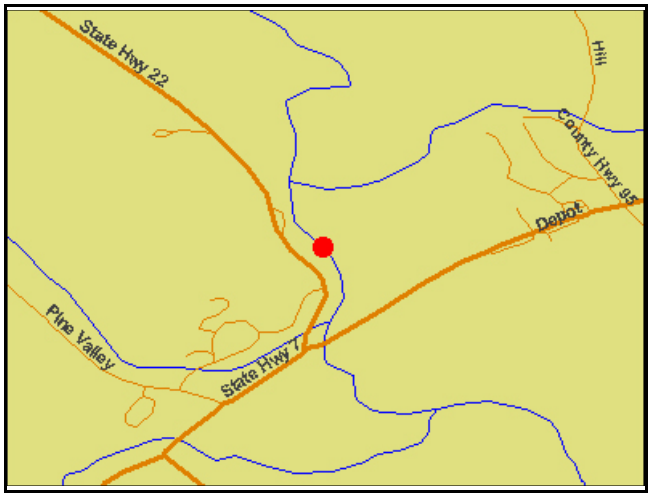
Date sampled: **Wednesday, July 18, 2007**

Arrival time at station: **8:17 AM**

Field personnel: **J. Kelly Nolan**

Physical Characteristics	
Width (meters)	**12**
Depth (meters)	**0.2**
Current (cm/sec)	**75**
Substrate (%)	
Rock (>25.4 cm or bedrock)	**10**
Rubble (6.35 - 25.4 cm)	**30**
Gravel (0.2 - 6.35 cm)	**40**
Sand (0.06 - 2.0 cm)	**15**
Silt (0.004 - 0.06 cm)	**5**
Embeddedness (%)	**25**
Chemical Measurements	
Temperature (C)	**20.86**
Specific conductance (umhos)	**277**
DO (mg/l)	**7**
DO % saturation	**78.4**
Baro pressure (mm)	**754**
pH	**7.31**
Salinity (PSS)	**0.13**
Biological Attributes	
Canopy (%)	**24**
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:



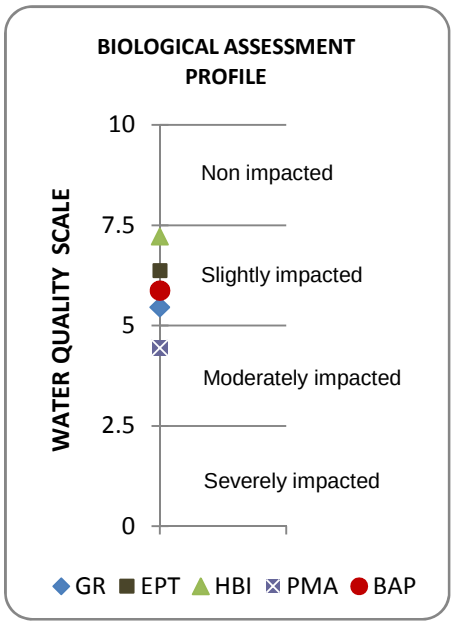
Latitude: 42.8604333
Longitude: -73.3403500
Degree Minutes

STREAM:	Hoosic River		
LOCATION:	400 meters below Rt. 7 bridge		
DATE:	18 July 2007		
SAMPLE TYPE:	Kick sample	ID:	HOOS
SUBSAMPLE:	100	STATION:	07
		REPLICATE:	D

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Undetermined Baetidae	1
		Acentrella sp.	2
	Ephemerellidae	Ephemerella sp.	2
	Isonychiidae	Isonychia sp.	2
	Caenidae	Caenis sp.	7
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	31
		Cheumatopsyche sp.	25
	Philopotamidae	Chimarra sp.	1
COLEOPTERA	Elmidae	Stenelmis sp.	1
		Optioservus sp.	1
DIPTERA	Chironomidae	Cricotopus bicinctus	1
		Polypedilum flavum	11
		Tvetenia sp.	2
		Cardiocladius obscurus	9
		Sublettea coffmani	1
		Parametriocnemus sp.	1
		Cricotopus trifascia gr.	2

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	17
BIOTIC INDEX:	4.73
EPT RICHNESS:	8
MODEL AFFINITY:	46
ASSESSMENT:	5.87 (Slightly impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	26
NPS NUTRIENTS:	**69**
SEWAGE:	57
IMPOUNDMENT:	64
MUNICIPAL/INDUSTRIAL:	62
TOXIC:	39
SILTATION:	49

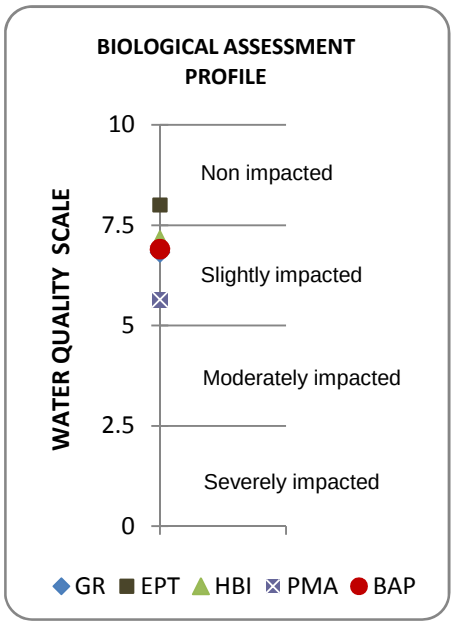
STREAM: Hoosic River
LOCATION: 400 meters below Rt. 7 bridge
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 07
REPLICATE: C

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia sp.	4
	Caenidae	Caenis sp.	4
	Baetidae	Baetis sp.	4
		Acentrella sp.	1
	Ephemerellidae	Ephemerella sp.	1
PLECOPTERA	Perlidae	Agnetina sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	32
		Cheumatopsyche sp.	13
	Hydroptilidae	Leucotrichia sp.	1
	Rhyacophilidae	Rhyacophila sp.	1
	Hydroptilidae	Hydroptila sp.	1
COLEOPTERA	Elmidae	Stenelmis sp.	4
		Optioservus sp.	3
DIPTERA	Empididae	Undetermined Empididae	1
	Chironomidae	Polypedilum flavum	14
		Cardiocladius obscurus	3
		Cricotopus tremulus gr.	4
		Tanytarsus sp.	1
		Tvetenia sp.	4
		Cricotopus trifascia gr.	3

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS: 20
BIOTIC INDEX: 4.78
EPT RICHNESS: 11
MODEL AFFINITY: 53
ASSESSMENT: 6.9 (Slightly impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL: 37
NPS NUTRIENTS: **76**
SEWAGE: 60
IMPOUNDMENT: 64
MUNICIPAL/INDUSTRIAL: 65
TOXIC: 46
SILTATION: 54

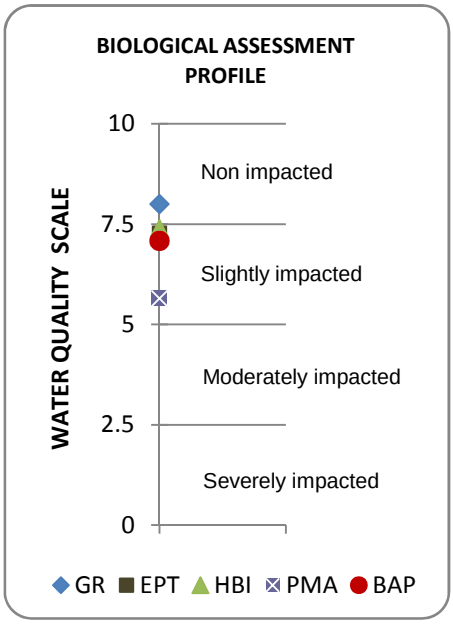
STREAM: Hoosic River
LOCATION: 400 meters below Rt. 7 bridge
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 07
REPLICATE: A

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia sp.	5
	Baetidae	Undetermined Baetidae	2
	Caenidae	Caenis sp.	1
	Baetidae	Baetis sp.	1
	Isonychiidae	Isonychia sp.	1
	Ephemerellidae	Ephemerella sp.	2
PLECOPTERA	Perlidae	Acroneuria sp.	1
		Paragnetina sp.	3
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	29
		Cheumatopsyche sp.	19
	Philopotamidae	Chimarra sp.	2
COLEOPTERA	Elmidae	Stenelmis sp.	1
		Optioservus sp.	4
DIPTERA	Athericidae	Atherix sp.	2
	Empididae	Hemerodromia sp.	1
	Chironomidae	Polypedilum flavum	15
		Cricotopus trifascia gr.	2
		Cricotopus tremulus gr.	5
		Sublettea coffmani	1
		Tanytarsus sp.	1
		Eukiefferiella sp.	1
		Cardiocladius obscurus	1

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	22
BIOTIC INDEX:	4.58
EPT RICHNESS:	10
MODEL AFFINITY:	53
ASSESSMENT:	7.1 (Slightly impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	38
NPS NUTRIENTS:	**71**
SEWAGE:	58
IMPOUNDMENT:	64
MUNICIPAL/INDUSTRIAL:	61
TOXIC:	43
SILTATION:	50

Field Data Summary

Stream name: **Hoosic River** Watershed: **Hudson** ID: **HOOS**

Location: **Just below Church St. bridge** Station: **08**

Municipality: **Hoosick Falls** **Rensselaer Co., NY**

Date sampled: **Wednesday, July 18, 2007**

Arrival time at station: **9:37 AM**

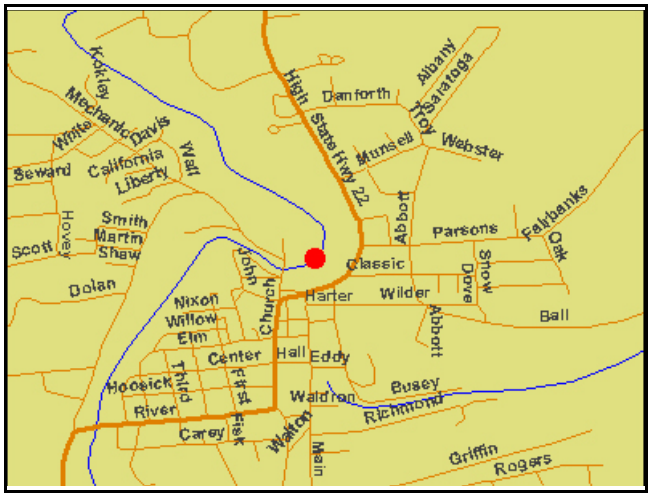
Field personnel: **J. Kelly Nolan**

Physical Characteristics	
Width (meters)	**25**
Depth (meters)	**0.25**
Current (cm/sec)	**90**
Substrate (%)	
Rock (>25.4 cm or bedrock)	**10**
Rubble (6.35 - 25.4 cm)	**35**
Gravel (0.2 - 6.35 cm)	**40**
Sand (0.06 - 2.0 cm)	**10**
Silt (0.004 - 0.06 cm)	**5**
Embeddedness (%)	**25**
Chemical Measurements	
Temperature (C)	**21.38**
Specific conductance (umhos)	**268**
DO (mg/l)	**8.06**
DO % saturation	**90.4**
Baro pressure (mm)	**766**
pH	**7.73**
Salinity (PSS)	**0.13**
Biological Attributes	
Canopy (%)	**24**
Aquatic vegetation	
Algae suspended	
Algae filamentous	**Y**
Diatoms	**Y**
Macrophytes	
Occurance of macroinvertebrates	
Ephemeroptera	**Y**
Plecoptera	**Y**
Trichoptera	**Y**
Coleoptera	**Y**
Megaloptera	
Odonata	
Chironomidae	**Y**
Simuliidae	
Decapoda	**Y**
Gammaridae	
Mollusca	
Oligochaeta	**Y**
Other macroinvertebrates	
Field faunal condition	**Very good**

Notes/observations:

Flow

Flow



Scale: 1 mile

Latitude: 42.9033833

Longitude: -73.3496500

Degree Minutes

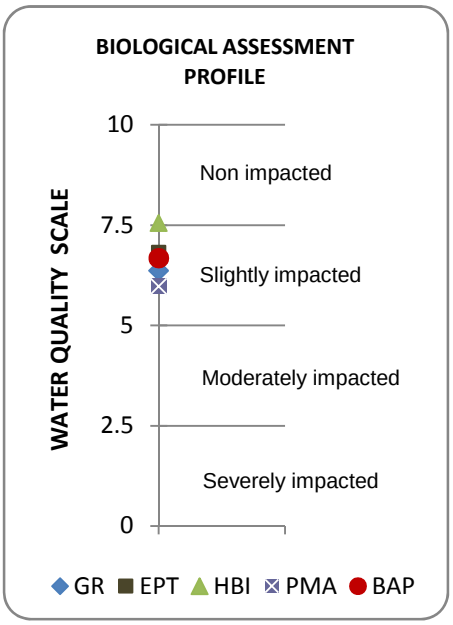
STREAM: Hoosic River
LOCATION: Just below Church St. bridge
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 08
REPLICATE: D

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia sp.	9
	Baetidae	Baetis sp.	3
		Acentrella sp.	2
	Heptageniidae	Undetermined Heptageniidae	4
	Caenidae	Caenis sp.	1
	Ephemerellidae	Ephemerella sp.	2
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	16
		Cheumatopsyche sp.	34
	Philopotamidae	Chimarra sp.	4
COLEOPTERA	Elmidae	Stenelmis sp.	10
	Gyrinidae	Dineutus sp.	1
DIPTERA	Empididae	Hemerodromia sp.	1
	Tipulidae	Antocha sp.	1
	Chironomidae	Cardiocladius obscurus	3
		Polypedilum flavum	5
		Tanytarsus sp.	1
		Cricotopus trifascia gr.	1
		Tvetenia vitracies	1
CRUSTACEA			
DECAPODA	Cambaridae	Undetermined Cambaridae	1

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	19
BIOTIC INDEX:	4.45
EPT RICHNESS:	9
MODEL AFFINITY:	55
ASSESSMENT:	6.67 (Slightly impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	46
NPS NUTRIENTS:	**72**
SEWAGE:	65
IMPOUNDMENT:	71
MUNICIPAL/INDUSTRIAL:	66
TOXIC:	46
SILTATION:	53

STREAM:	Hoosic River		
LOCATION:	Just below Church St. bridge		
DATE:	18 July 2007		
SAMPLE TYPE:	Kick sample	ID:	HOOS
SUBSAMPLE:	100	STATION:	08
		REPLICATE:	B

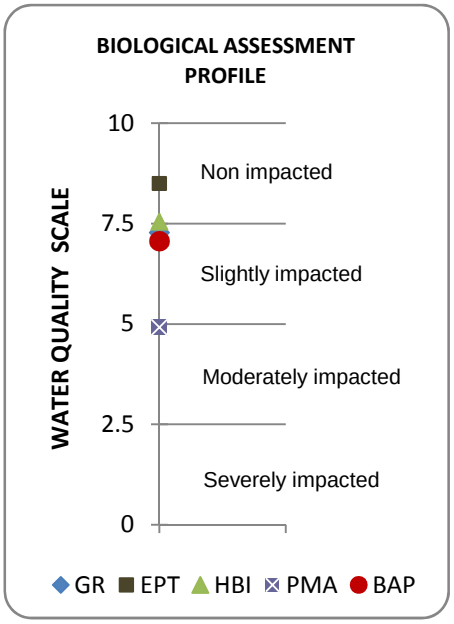
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Polymitarcyidae	Ephoron sp.	1
	Isonychiidae	Isonychia sp.	3
	Baetidae	Acentrella sp.	1
	Ephemerellidae	Serratella sp.	1
		Undetermined Ephemerellidae	4
	Caenidae	Caenis sp.	3
	Ephemerellidae	Ephemerella sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	28
	Philopotamidae	Chimarra sp.	3
	Hydropsychidae	Cheumatopsyche sp.	20
	Psychomyiidae	Psychomyia flavida	1
	Hydroptilidae	Leucotrichia sp.	2
COLEOPTERA	Elmidae	Stenelmis sp.	10
		Optioservus sp.	7
DIPTERA	Chironomidae	Cardiocladius obscurus	3
		Tvetenia vitracies	1
		Cricotopus trifascia gr.	1
		Polypedilum flavum	7
		Cricotopus tremulus gr.	1
		Undetermined Orthocladiinae	1
ANNELIDA			
OLIGOCHAETA			
		Undetermined Oligochaeta	1

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	21
BIOTIC INDEX:	4.45
EPT RICHNESS:	12
MODEL AFFINITY:	49
ASSESSMENT:	7.06 (Slightly impacted)

IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	43
NPS NUTRIENTS:	**74**
SEWAGE:	63
IMPOUNDMENT:	65
MUNICIPAL/INDUSTRIAL:	66
TOXIC:	48
SILTATION:	52



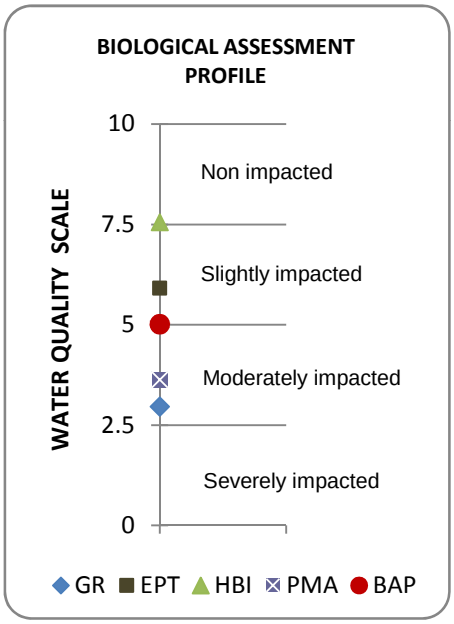
STREAM: Hoosic River
LOCATION: Just below Church St. bridge
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 08
REPLICATE: A

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia sp.	5
	Baetidae	Acentrella sp.	2
	Ephemerellidae	Ephemerella sp.	2
	Baetidae	Baetis sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	29
	Philopotamidae	Chimarra sp.	2
	Hydropsychidae	Cheumatopsyche sp.	32
COLEOPTERA	Elmidae	Stenelmis sp.	12
		Optioservus sp.	4
DIPTERA	Athericidae	Atherix sp.	1
	Chironomidae	Cardiocladius obscurus	5
		Polypedilum flavum	5

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	12
BIOTIC INDEX:	4.45
EPT RICHNESS:	7
MODEL AFFINITY:	41
ASSESSMENT:	5.01 (Slightly impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	41
NPS NUTRIENTS:	**69**
SEWAGE:	62
IMPOUNDMENT:	62
MUNICIPAL/INDUSTRIAL:	**65**
TOXIC:	47
SILTATION:	47

Field Data Summary

Stream name: **Hoosic River** Watershed: **Hudson** ID: **HOOS**

Location: **End of Markers Rd.** Station: **09**

Municipality: **Hoosick Falls** **Rensselaer Co., NY**

Date sampled: **Wednesday, July 18, 2007**

Arrival time at station: **10:46 AM**

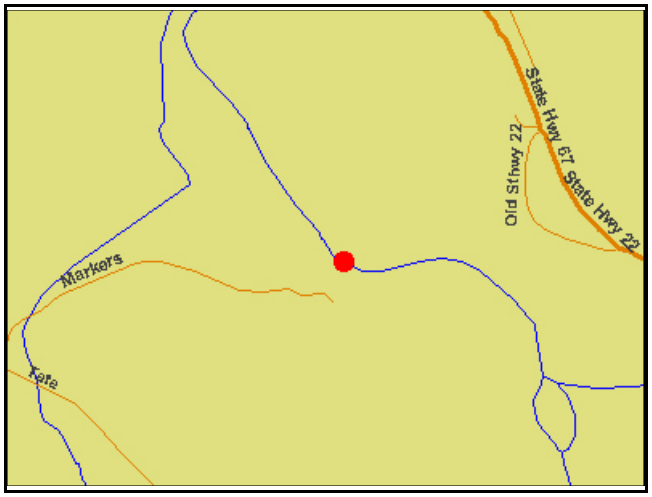
Field personnel: **J. Kelly Nolan**

Physical Characteristics	
Width (meters)	**80**
Depth (meters)	**0.25**
Current (cm/sec)	**55**
Substrate (%)	
Rock (>25.4 cm or bedrock)	**5**
Rubble (6.35 - 25.4 cm)	**25**
Gravel (0.2 - 6.35 cm)	**50**
Sand (0.06 - 2.0 cm)	**15**
Silt (0.004 - 0.06 cm)	**5**
Embeddedness (%)	**25**
Chemical Measurements	
Temperature (C)	**21.56**
Specific conductance (umhos)	**260**
DO (mg/l)	**8.27**
DO % saturation	**92.3**
Baro pressure (mm)	**766**
pH	**7.85**
Salinity (PSS)	**0.12**
Biological Attributes	
Canopy (%)	**24**
Aquatic vegetation	
Algae suspended	
Algae filamentous	**Y**
Diatoms	**Y**
Macrophytes	
Occurance of macroinvertebrates	
Ephemeroptera	**Y**
Plecoptera	**Y**
Trichoptera	**Y**
Coleoptera	**Y**
Megaloptera	
Odonata	
Chironomidae	**Y**
Simuliidae	
Decapoda	**Y**
Gammaridae	
Mollusca	
Oligochaeta	
Other macroinvertebrates	
Field faunal condition	**Very good**

Notes/observations:

Flow

Flow



Scale: 1 mile

Latitude: 42.9335667

Longitude: -73.3744000

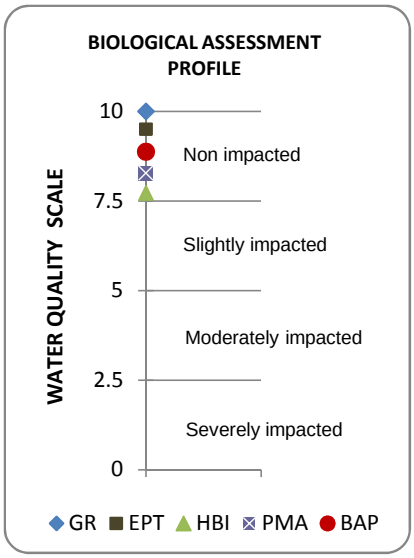
Degree Minutes

STREAM: Hoosic River
LOCATION: End of Markers Rd.
DATE: 18 July 2007
SAMPLE TYPE: Kick sample — ID: HOOS
SUBSAMPLE: 100 — STATION: 09
REPLICATE: D

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia sp.	3
	Polymitarcyidae	Ephoron sp.	4
	Potamanthidae	Anthopotamus sp.	1
	Baetidae	Acentrella sp.	2
	Ephemerellidae	Ephemerella sp.	5
	Caenidae	Caenis sp.	1
	Heptageniidae	Stenonema femoratum	1
	Baetidae	Baetis sp.	1
		Baetis brunneicolor	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	16
		Cheumatopsyche sp.	9
	Brachycentridae	Brachycentrus sp.	1
	Glossosomatidae	Undetermined Glossosomatidae	1
	Psychomyiidae	Psychomyia flavida	1
COLEOPTERA	Elmidae	Optioservus sp.	4
		Stenelmis sp.	10
		Oulimnius sp.	1
DIPTERA	Tipulidae	Antocha sp.	12
	Chironomidae	Tvetenia vitracies	4
		Cricotopus tremulus gr.	6
		Cricotopus trifascia gr.	1
		Tanytarsus sp.	1
		Polypedilum flavum	5
		Cardiocladius obscurus	2
		Microtendipes pedellus gr.	1
		Cricotopus bicinctus	1
		Cardiocladius albiplumus	1
NEMERTEA			
		Prostoma graecense	1
ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	3

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS:	29
BIOTIC INDEX:	4.28
EPT RICHNESS:	14
MODEL AFFINITY:	72
ASSESSMENT:	8.9 (Non impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL:	47
NPS NUTRIENTS:	**56**
SEWAGE:	46
IMPOUNDMENT:	49
MUNICIPAL/INDUSTRIAL:	45
TOXIC:	47
SILTATION:	**55**

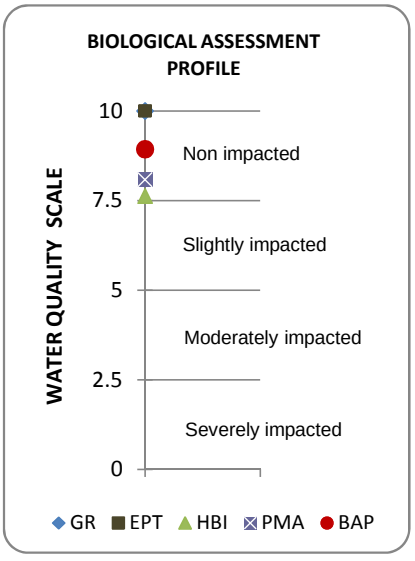
STREAM: Hoosic River
LOCATION: End of Markers Rd.
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 09
REPLICATE: C

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Potamanthidae	Anthopotamus sp.	8
	Polymitarcyidae	Ephoron sp.	1
	Heptageniidae	Maccaffertium sp.	1
	Ephemerellidae	Ephemerella sp.	7
	Leptohyphidae	Tricorythodes sp.	1
	Caenidae	Caenis sp.	2
	Baetidae	Baetis brunneicolor	1
		Baetis sp.	2
PLECOPTERA	Perlidae	Perlesta sp.	2
		Agnetina sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	9
		Cheumatopsyche sp.	8
	Brachycentridae	Brachycentrus sp.	1
	Hydroptilidae	Leucotrichia sp.	1
	Psychomyiidae	Psychomyia flavida	1
COLEOPTERA	Elmidae	Optioservus sp.	1
		Stenelmis sp.	6
DIPTERA	Tipulidae	Antocha sp.	5
	Chironomidae	Tvetenia vitracies	2
		Sublettea coffmani	13
		Cardiocladius obscurus	5
		Polypedilum flavum	10
		Tanytarsus sp.	2
		Cricotopus tremulus gr.	1
		Rheotanytarsus sp.	1
		Microtendipes pedellus gr.	3
		Thienemannimyia gr. spp.	2
		Cricotopus trifascia gr.	1
ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	2

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS: 29
BIOTIC INDEX: 4.38
EPT RICHNESS: 15
MODEL AFFINITY: 70
ASSESSMENT: 8.92 (Non impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL: 45
NPS NUTRIENTS: 45
SEWAGE: 46
IMPOUNDMENT: 48
MUNICIPAL/INDUSTRIAL: 49
TOXIC: 40
SILTATION: **51**

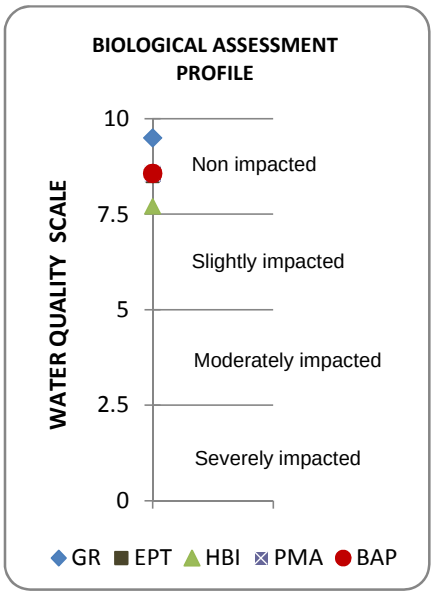
STREAM: Hoosic River
LOCATION: End of Markers Rd.
DATE: 18 July 2007
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100

ID: HOOS
STATION: 09
REPLICATE: A

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Polymitarcyidae	Ephoron sp.	2
	Isonychiidae	Isonychia sp.	2
	Ephemerellidae	Ephemerella sp.	10
	Baetidae	Baetis brunneicolor	3
		Baetis sp.	5
		Acentrella sp.	3
	Leptophlebiidae	Paraleptophlebia sp.	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	6
		Hydropsyche sp.	12
	Brachycentridae	Brachycentrus sp.	1
	Hydroptilidae	Hydroptila sp.	2
	Rhyacophilidae	Rhyacophila sp.	1
COLEOPTERA	Elmidae	Stenelmis sp.	4
		Optioservus sp.	4
DIPTERA	Tipulidae	Antocha sp.	7
	Chironomidae	Cricotopus tremulus gr.	4
		Polypedilum flavum	4
		Cricotopus trifascia gr.	9
		Cardiocladius obscurus	2
		Tvetenia vitracies	6
		Cricotopus bicinctus	3
		Tanytarsus sp.	1
		Sublettea coffmani	3
		Microtendipes pedellus gr.	1
ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	3

BIOLOGICAL ASSESSMENT PROFILE (BAP)

GENERA RICHNESS: 25
BIOTIC INDEX: 4.29
EPT RICHNESS: 12
MODEL AFFINITY: 75
ASSESSMENT: 8.56 (Non impacted)



IMPACT SOURCE DETERMINATION (ISD)

NATURAL: **51**
NPS NUTRIENTS: 49
SEWAGE: **56**
IMPOUNDMENT: 50
MUNICIPAL/INDUSTRIAL: 45
TOXIC: **52**
SILTATION: 53

TOTAL TAXA LIST Hoosic River, Rensselaer Co., NY July 18, 2007 Stations 07, 08, and 09

ORDER	FAMILY	GENUS/SPECIES
		Undetermined Oligochaeta
LUMBRICULIDA	Lumbriculidae	*Undetermined Lumbriculidae*
DECAPODA	Cambaridae	*Undetermined Cambaridae*
COLEOPTERA	Elmidae	*Optioservus sp.*
		Oulimnius sp.
		Stenelmis sp.
	Gyrinidae	*Dineutus sp.*
DIPTERA	Athericidae	*Atherix sp.*
	Chironomidae	*Cardiocladius albiplumus*
		Cardiocladius obscurus
		Cricotopus bicinctus
		Cricotopus tremulus gr.
		Cricotopus trifascia gr.
		Eukiefferiella sp.
		Microtendipes pedellus gr.
		Parametriocnemus sp.
		Polypedilum flavum
		Rheotanytarsus sp.
		Sublettea coffmani
		Tanytarsus sp.
		Thienemannimyia gr. spp.
		Tvetenia sp.
		Tvetenia vitracies
		Undetermined Orthocladiinae
	Empididae	*Hemerodromia sp.*
		Undetermined Empididae
	Tipulidae	*Antocha sp.*
EPHEMEROPTERA	Baetidae	*Acentrella sp.*
		Baetis brunneicolor
		Baetis sp.
		Undetermined Baetidae
	Caenidae	*Caenis sp.*
	Ephemerellidae	*Ephemerella sp.*
		Serratella sp.
		Undetermined Ephemerellidae
	Heptageniidae	*Maccaffertium sp.*
		Stenonema femoratum

TOTAL TAXA LIST Hoosic River, Rensselaer Co., NY July 18, 2007 Stations 07, 08, and 09

ORDER	FAMILY	GENUS/SPECIES
EPHEMEROPTERA	Heptageniidae	*Undetermined Heptageniidae*
	Isonychiidae	*Isonychia sp.*
	Leptohyphidae	*Tricorythodes sp.*
	Leptophlebiidae	*Paraleptophlebia sp.*
	Polymitarcyidae	*Ephoron sp.*
	Potamanthidae	*Anthopotamus sp.*
PLECOPTERA	Perlidae	*Acroneuria sp.*
		Agnetina sp.
		Paragnetina sp.
		Perlesta sp.
TRICHOPTERA	Brachycentridae	*Brachycentrus sp.*
	Glossosomatidae	*Undetermined Glossosomatidae*
	Hydropsychidae	*Cheumatopsyche sp.*
		Hydropsyche sp.
	Hydroptilidae	*Hydroptila sp.*
		Leucotrichia sp.
	Philopotamidae	*Chimarra sp.*
	Psychomyiidae	*Psychomyia flavida*
	Rhyacophilidae	*Rhyacophila sp.*
		Prostoma graecense