Wood-Pawcatuck Watershed Association

2005
BENTHIC MACROINVERTEBRATE SAMPLING ON SELECTED STREAMS IN THE PAWCATUCK WATERSHED

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ABSTRACT:
Aquatic Benthic macroinvertebrate sampling was conducted by the Wood-Pawcatuck Watershed Association (WPWA) at eight sites on four streams in the Pawcatuck Watershed using EPA Rapid Bioassessment Protocols. Sites on the Wood River, Queen River, Beaver River, and Meadow Brook were selected to correspond with sites included in water withdrawal modeling for the Pawcatuck Optimization Project. Organisms were collected in the field, preserved, and taken to WPWA offices to be identified. Coarse level identification, down to order and family level, was conducted by WPWA staff. Relative water quality was assigned using the New York State Biological Assessment Profile (NYS BAP). The findings, based on the mean of four metrics, rated five sites as non-impact to water quality and three sites as slight impact. However, all of the sites had at least one metric that was rated as slight impact. Sampling was done during the summer of 2005, which experienced lower than normal precipitation. The consequential low flows may have influenced the results of this study by degrading the aquatic habitat for macroinvertebrates. These results demonstrate that the relative water quality assessment used in this study can be a sensitive indictor of changes in environmental factors. Further sampling at these same sites should be done to verify this deduction.

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INTRODUCTION

The Wood-Pawcatuck Watershed Association (WPWA) continued a multi-year macroinvertebrate sampling program on selected sites in the Pawcatuck Watershed during the summer of 2005. Samples were collected from eight sites on four streams: Meadow Brook, Queen River, Beaver River, and Wood River. These streams were selected to correspond with sites under study as part of the Pawcatuck Optimization Project, a joint effort of USDA Natural Resource Conservation Service and the US Geological Survey. The objective of the optimization project is to create models that can predict effects of variations in groundwater and surface water flows based on several different scenarios of water withdrawal. This macroinvertebrate sampling contributes to the overall project.

Of significant concern in the Pawcatuck Watershed is the future of water supply and groundwater withdrawal for agricultural irrigation, commercial and industrial uses, and municipal drinking water supplies. The Pawcatuck Watershed supports 10 sand and gravel aquifers which together constitute a sole-source aquifer system. These aquifers have a potential high yield withdrawal rate of between 5 million and 18 million gallons per day (Wild and Nimiroski, 2004). Typical of the geology of this region, these aquifers under lay several large and small streams. In the summer, during seasonal low flows, groundwater from the aquifers contributes a significant amount of water to the stream flow. The concern is that diversion of groundwater for other purposes may greatly reduce the available water to the streams, resulting in detrimental impacts to the stream ecology. Six of the sites sampled are areas that are being considered by the state for future water withdrawals. In conducting this sampling program, WPWA's intent is to establish a baseline for relative water quality based on benthic aquatic macroinvertebrate communities so that an assessment can later be made of potential impacts

from future withdrawals. Biological sampling, in connection with other water quality parameters, is a useful tool in this regard.

METHODS

Using the EPA methodology for Rapid Bioassessment Protocol (US EPA, 1997 and 1999), WPWA sampled 8 sites on 4 streams. An 18 in. x 8 in. (45.72 cm x 20.32 cm) rectangular collection net with a 0.59 mm mesh was used. Collections were done for three minutes, for a total of 3 replicates at each riffle site. Rocks were picked up within a 1 square foot square (0.3 m) area in front of the net, rubbed into the net, and saved in a bucket to be examined for more organisms. Substrate was then kicked up into the net for the remainder of the 3 minutes. All organisms were collected from the rocks and net at the site, preserved in 95% alcohol, and returned to WPWA headquarters for sub-sampling. There, the sample was spread on a 9 x 13 inch tray that was divided into a grid containing 12 numbered squares. Numbers were randomly selected, and organisms from the corresponding numbered square were retrieved and counted, until at least 100 organisms were obtained. This took an average of 5 squares per sample. The organisms were identified to order and, when appropriate, to family level. All organisms were preserved and saved in 70% ethanol.

Identification of organisms was done by WPWA staff. Initial sorting and identification was performed by Michele Hetu**,** using identification keys, guide books, and a dissecting microscope. Each sample was re-checked by Denise Poyer. Specific resources and key guides used are listed in the bibliography. Worksheets for each of the sites listing all of the organisms identified are found in Appendix A.

MULTI METRIC ANALYSIS

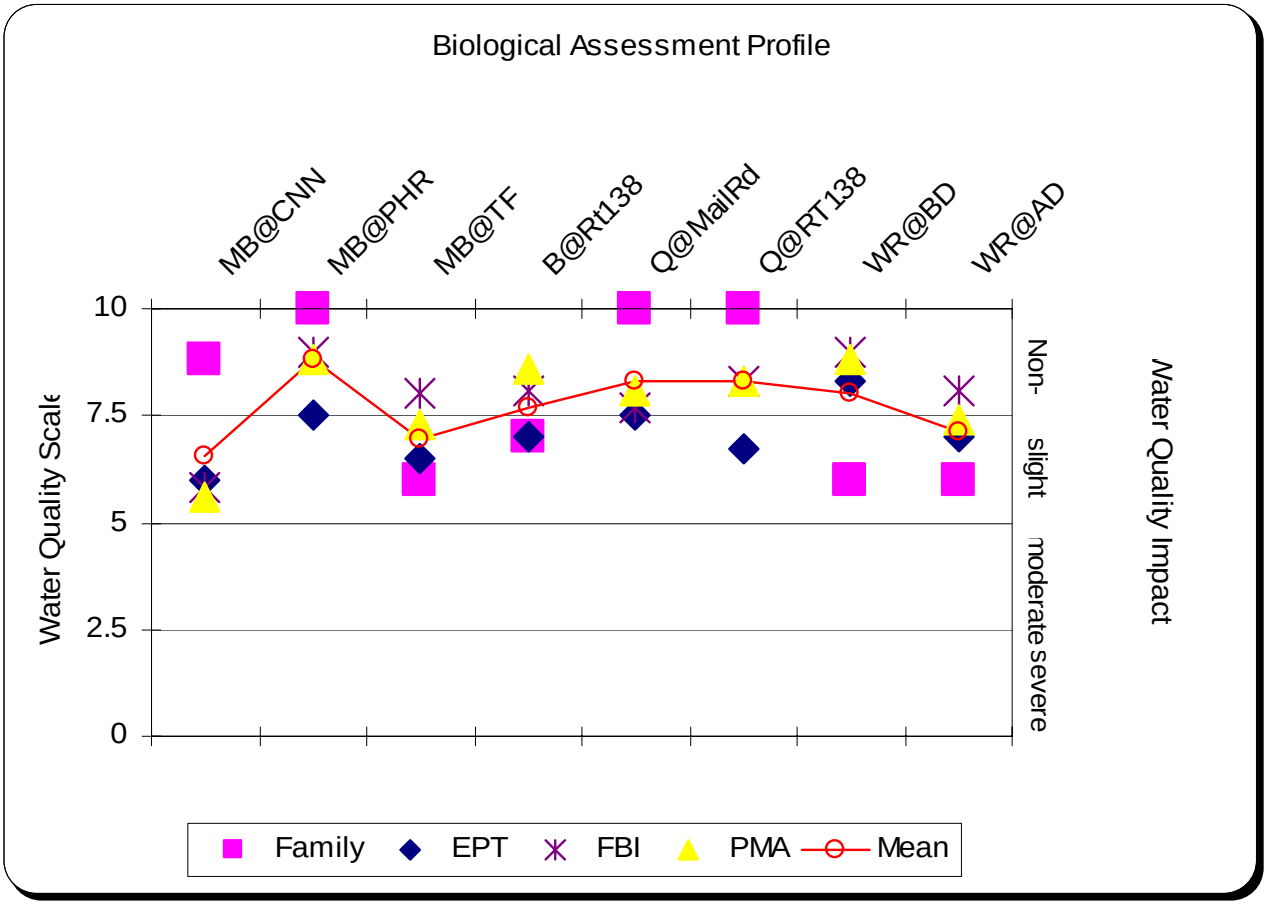
The Rhode Island Department of Environmental Management (RIDEM) does not currently have an approved, multi-metric format for analyzing macroinvertebrate data. In the 2004 Macroinvertebrate Report, WPWA compared a RIDEM prototype with several other formats used by New England states, and ultimately decided to utilize the New York State Biological Assessment Profile (NYS BAP) used by New York State Department of Environmental Control (NYSDEC).

The NYS BAP uses a Family Level Benthic Macroinvertebrate Data Analysis Sheet. This method of assessing water quality seems the most desirable for several reasons. First, it is practical for an organization with limited resources to use only family level identification. Second, NYS BAP focuses on only four key indices: a) EPT (Ephemeroptera, Plecoptera, and Trichoptera) Richness, b) Family Richness, c) Family Biotic Index (FBI), and d) Percent Model Affinity (PMA). (See Appendix B). These indices seem to be the four most effective metrics in that they are sensitive to changes due to human influence (Schaefer, Gido, and Smith, 2005; Karr, 1999). Third, once these indices have been calculated, they can be converted to a scale of 1 to 10 for a more comprehensible comparison. A relative water quality index of Non-, Slight, Moderate, or Severe Impact can be assigned, based on the scores (Appendix C). Although the Hudson Basin River Watch (HBRW) worksheets were used, some changes were made to reflect RI conditions. To calculate the Family Biotic Index, the tolerance levels for families in Rhode Island **(**as developed by Dr. Mark Gould and revised by Sara DaSilva and Ben Jessup in 2003**)** were utilized (Jessup, 2003). Stream sample results from the Wood River for 2001, the same data used by the RIDEM as a reference site for the state (DaSilva, 2003), were used for the model reference.

RESULTS

The four streams examined-- Beaver, Wood, and Queen Rivers, and Meadow Brook-- were sampled during historically low flows of July and August. Five sites had a mean rating that showed non-impact to water quality. Three sites showed slight impact. One site on the Meadow Brook that was intended to be sampled had no flow during the sampling period. In 2005, the summer months of June, July, and August received lower than normal precipitation (NOAA website), causing lower than normal flows in the streams. This may have affected the water quality ratings for all of the sites in that low flows tend to degrade the riffle habitats for aquatic benthic macroinvertebrates. All of the sites had at least one metric that rated slight impact. The results of the multi-metric analysis are shown in Table 1.

TABLE 1



The three sites sampled on the Meadow Brook were (from upstream to downstream) Carolina Nooseneck Road (MB@CNN), Carolina Management Area just north of Pine Hill Road (MB@PHR), and a section near the Tuckahoe Turf Farms (MB@TF), just north of the outlet to Meadow Brook Pond. The first and third site showed slight impact to water quality, while the second site showed none, except on the EPT index. The first site, part of the headwaters of the stream, is less than 6 feet across at the sampling point. The slight impact rating could be attributed to the low flow at the site, or it could be that the metrics used are not adequate measures in such a small stream. The second site is located in a management area where an expected result would be no apparent impact. The lower EPT rating may be the result of lower than normal stream flow. The third site is in an area with a vegetated buffer of about 200 feet on either side of the stream. The stream flows between two active agricultural fields for about 1 mile. The rating of slight impact could reflect the land use near the stream**,** but also might be the result of the low water flow. Previous observations made at this site showed that the EPT and biodiversity were good, although the current protocols and metrics were not used.

One site on the Beaver River (BR@RT138) and two sites on the Queen (Q@MailRd and Q@RT138) were rated as non-impacted. The EPT for all three sites was rated as slight impact. In 2004, WPWA sampled different sites with similar habitats on both the Beaver and Queen Rivers. The ratings for the 2004 sites were all non-impact. In comparing the 2005 and 2004 sites, no statistically significant differences between the metric results were evident.

The two sites on the Wood River were below Barberville Dam (WR@BD), which is a common reference site, and below Alton Dam (WR@AD). The first site had a mean rating of non-impact while the second site showed slight impact. This rating was higher than expected, given its proximity to the dam. The water above dams tends to be warmer due to ponding. This

warmer water can affect the aquatic fauna below the dam. WPWA staff was present when another site, below the Alton Dam adjacent to the Charbert industrial plant, was sampled for macroinvertebrates by a consultant for RIDEM. This site was approximately 0.25 mile downstream from WPWA's site, and 0.1 mile above the confluence of the Wood River with the Pawcatuck River. Because there were no adequate riffles to sample, the consultants did a kick sample of the substrate. The substrate was observed to be heavily silted over coarse gravel, sand and boulders. Coarse examination of the sample in the field revealed no visible macroinvertebrates. The lack of macroinvertebrates could be attributed to adverse conditions created by industrial discharge. Laboratory results from this test are pending, and a comparison will be made when they become available.

CONCLUSIONS

The objective of WPWA's 2005 benthic macroinvertebrate sampling program was to establish a baseline water quality rating of three streams in the Pawcatuck Watershed using benthic aquatic macroinvertebrates as indicators of relative water quality.

Recent discussion of future water supply development in Rhode Island has revealed that that the Beaver and Queen Rivers, and Meadow Brook, may be targeted for proposed large volume water withdrawals in the coming decade. WPWA selected at least one site on each of these stream that would correspond to a likely point or points of proposed withdrawal. Out of 8 sites, 7 had EPT ratings of slight impact. Only the Wood River at Barberville Dam had a relatively good EPT result. This may be the best indication of the low flow impact across the watershed. These streams demonstrate sensitivity to climatic variables, such as lower than normal precipitation of the 2005 summer months. If there is the added stress of water

withdrawals during summer months, then it is possible that the habitat quality of the streams may be degraded to the point of being unable to support native fauna. The goal of the Pawcatuck Optimization Project is to allow scientists to predict the potential impact of water withdrawals on surface water flows, and the related impacts to aquatic habitat.

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APPENDIX A

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Carolina Nooseneck Road
River/Stream/Town: **Meadow Brook,** Richmond RI
Date Sampled: 7/28/2005
Name(s): Danielle Aube, Michele Hetu, Sue Cerullo
Date of Lab Work: 8/16/2005 V4/26/06

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebiidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythidae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			0	0	0
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	1	1	1	0.009
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			1	1	0.009
MEGALOPTERA (M)					
Corydalidae	0	2	2	0	0.018
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			2	0	0.018
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	13	13	52	0.117
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		1	1	0	0.009
Subtotal C			14	52	0.126
ODONATA (O)					
Aeshnidae	3	1	1	3	0.009
Calopterygidae	5	2	2	10	0.018
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	2	2	2	0.018
Lestidae	9	0	0	0	0
Libellulidae	2	2	2	4	0.018
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			7	19	0.063
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	1
# Trichoptera Families	3
EPT Richness (Total)	4

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

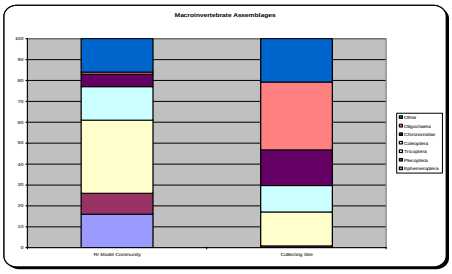
Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	9	9	36	0.081
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	7	7	0	0.063
Philopotamidae	3	0	0	0	0
Phryganeidae	4	2	2	8	0.018
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			18	44	0.162
DIPTERA (D)					
Athericidae	2	7	7	14	0.063
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	19	19	114	0.171
Tipulidae	4	7	7	28	0.063
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			33	156	0.297
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	36	36	324	0.324
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			36	324	0.324
TOTALS			111	596	1

Organism Density/Sample Unit	266.4
EPT Richness	4
Total Family Richness	15
EPT/EPT+Chironomidae Ratio	0.50
Biotic Index	5.37
% Contribution of Dominant Family	32%
% Model Affinity	53%

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	0%
PLECOPTERA	1%
TRICHOPTERA	16%
CHIRONOMIDAE	17%
OTHER DIPTERA	13%
COLEOPTERA	13%
ODONATA	6%
MEGALOPTERA	2%
LEPIDOPTERA	0%
AMPHIPODA	0%
ISOPODA	0%
OLIGOCHAETA	32%
GASTROPODA	0%
PELECYPODA	0%
OTHER	0%

Ephemeroptera	16	0
Plecoptera	10	1
Tricoptera	35	16
Coleoptera	16	13
Chironomidae	6	17
Oligochaeta	1	32
Other	16	21



Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: north of Pine Hill Road, Carolina Mgmt Area
River/Stream/Town: Meadow Brook, Richmond RI
Date Sampled: 8/2/2005
Name(s): Danielle Aube, Michelle Hetu
Date of Lab Work: 5/12/2006

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12
Replicate #	1	

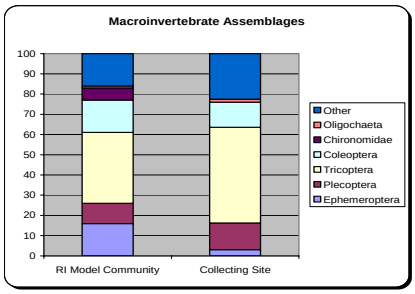
I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	4	4	16	0.031
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			4	16	0.031
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	9	9	0	0.07
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	8	8	8	0.062
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			17	8	0.132
MEGALOPTERA (M)					
Corydalidae	0	9	9	0	0.07
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			9	0	0.07
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	16	16	64	0.124
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			16	64	0.124
ODONATA (O)					
Aeshnidae	3	10	10	30	0.078
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			10	30	0.078
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	3	3	18	0.023
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			3	18	0.023

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	2	2	0	0.016
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	25	25	100	0.194
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	3	3	12	0.023
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	31	31	93	0.24
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			61	205	0.473
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	1	1	4	0.008
Empididae	6	0	0	0	0
Simuliidae	6	4	4	24	0.031
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		1	1	0	0.008
Subtotal D			6	28	0.047
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	2	2	18	0.016
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		1	1	0	0.008
Subtotal Other			3	18	0.023

TOTALS		129	387	1

Organism Density/Sample Unit	309.6
EPT Richness	7
Total Family Richness	16
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	3.00
% Contribution of Dominant Family	24%
% Model Affinity	78%

Ephemerop	16	3
Plecoptera	10	13
Tricoptera	35	47
Coleoptera	16	12
Chironomi	6	0
Oligochae	1	2
Other	16	22



EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	1
# Plecoptera Families	2
# Trichoptera Families	4
EPT Richness (Total)	7

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		3%
PLECOPTERA		13%
TRICHOPTERA		47%
CHIRONOMIDAE		0%
OTHER DIPTERA		5%
COLEOPTERA		12%
ODONATA		8%
MEGALOPTERA		7%
LEPIDOPTERA		0%
AMPHIPODA		2%
ISOPODA		0%
OLIGOCHAETA		2%
GASTROPODA		0%
PELECYPODA		0%
OTHER		1%

Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Turf Fields, above Pond
River/Stream/Town: Meadow Brook, Richmond RI
Date Sampled: 7/25/2005
Name(s): Aube, Hetu
Date of Lab Work: 5/12/2006

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	1	1	4	0.01
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	4	4	16	0.04
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythidae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			5	20	0.05
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	0	0	0	0
Perlodidae	2	13	13	26	0.13
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			13	26	0.13
MEGALOPTERA (M)					
Corydalidae	0	13	13	0	0.13
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			13	0	0.13
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	8	8	32	0.08
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			8	32	0.08
ODONATA (O)					
Aeshnidae	3	4	4	12	0.04
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			4	12	0.04
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	27	27	162	0.27
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			27	162	0.27

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	22	22	88	0.22
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	0	0	0	0
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
Bearacidae	1	1	1	1	0.01
Other		0	0	0	0
Subtotal T			23	89	0.23
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			0	0	0
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	6	6	54	0.06
Hirudinea	10	0	0	0	0
Gastropoda	6	1	1	6	0.01
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			7	60	0.07

TOTALS		100	401	1

Organism Density/Sample Unit	240
EPT Richness	5
Total Family Richness	11
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	4.01
% Contribution of Dominant Family	27%
% Model Affinity	63%

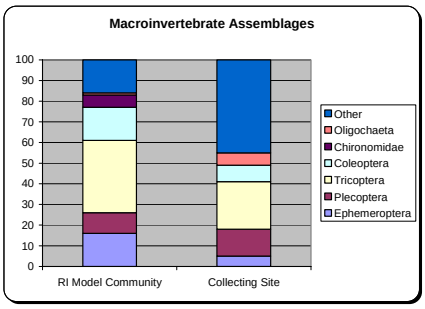
EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	1
# Trichoptera Families	2
EPT Richness (Total)	5

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	5%
PLECOPTERA	13%
TRICHOPTERA	23%
CHIRONOMIDAE	0%
OTHER DIPTERA	0%
COLEOPTERA	8%
ODONATA	4%
MEGALOPTERA	13%
LEPIDOPTERA	0%
AMPHIPODA	27%
ISOPODA	0%
OLIGOCHAETA	6%
GASTROPODA	1%
PELECYPODA	0%
OTHER	0%

Ephemeroptera	16	5
Plecoptera	10	13
Tricoptera	35	23
Coleoptera	16	8
Chironomidae	6	0
Oligochaeta	1	6
Other	16	45



Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: south of Mail Road bridge | River/Stream/Town: Queen River, Exster, RI

Date Sampled: 8/4/2005 | Name(s): Poyer, Aube, Hetu

Date of Lab Work: 9/15/2005 V5/11/06

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	2	2	8	0.02
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	0	0	0	0
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	2	2	4	0.02
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			4	12	0.04
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	2	2	0	0.02
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	8	8	8	0.079
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			10	8	0.099
MEGALOPTERA (M)					
Corydalidae	0	1	1	0	0.01
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			1	0	0.01
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	29	29	116	0.287
Gyrinidae	4	1	1	4	0.01
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		1	1	0	0.01
Subtotal C			31	120	0.307
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	2	2	2	0.02
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			2	2	0.02
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	3
EPT Richness (Total)	7

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

Replicate # 1

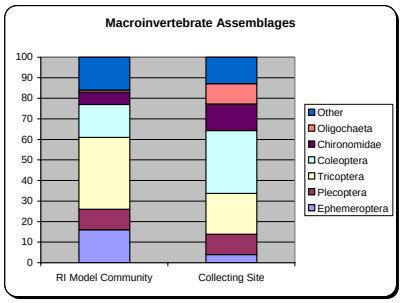
I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	15	15	60	0.149
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	4	4	16	0.04
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	0	0	0	0
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		1	1	0	0.01
Subtotal T			20	76	0.198
DIPTERA (D)					
Athericidae	2	4	4	8	0.04
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	13	13	78	0.129
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	6	6	36	0.059
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			23	122	0.228
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	10	10	90	0.099
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			10	90	0.099

TOTALS		101	430	1

Organism Density/Sample Unit	242.4
EPT Richness	7
Total Family Richness	16
EPT/EPT+Chironomidae Ratio	0.72
Biotic Index	4.26
% Contribution of Dominant Family	29%
% Model Affinity	70%

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	4%
PLECOPTERA	10%
TRICHOPTERA	20%
CHIRONOMIDAE	13%
OTHER DIPTERA	10%
COLEOPTERA	31%
ODONATA	2%
MEGALOPTERA	1%
LEPIDOPTERA	0%
AMPHIPODA	0%
ISOPODA	0%
OLIGOCHAETA	10%
GASTROPODA	0%
PELECYPODA	0%
OTHER	0%

Ephemeroptera	16	4
Plecoptera	10	10
Tricoptera	35	20
Coleoptera	16	31
Chironomidae	6	13
Oligochaeta	1	10
Other	16	13



Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: north of Rt. 138 bridge
River/Stream/Town: Usquepaug (Queen) River, South Kingstown, RI
Date Sampled: 8/9/2005
Name(s): Aube, Hetu
Date of Lab Work: 8/22/2005 V4/18/06

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\bar{D}$	T x $\bar{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	5	5	20	0.045
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	2	2	4	0.018
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			7	24	0.063
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	2	2	2	0.018
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			2	2	0.018
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			0	0	0
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	19	19	76	0.17
Gyrinidae	4	1	1	4	0.009
Haliplidae	5	0	0	0	0
Psephenidae	4	6	6	24	0.054
		0	0	0	0
Other		0	0	0	0
Subtotal C			26	104	0.232
ODONATA (O)					
Aeshnidae	3	1	1	3	0.009
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	2	2	18	0.018
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			3	21	0.027
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

Replicate #	1

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\bar{D}$	T x $\bar{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	27	27	108	0.241
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	1	1	1	0.009
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	35	35	105	0.313
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			63	214	0.563
DIPTERA (D)					
Athericidae	2	1	1	2	0.009
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	2	2	12	0.018
Tipulidae	4	2	2	8	0.018
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			5	22	0.045
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	1	1	10	0.009
Gastropoda	6	2	2	12	0.018
Pelecypoda	8	0	0	0	0
Turbellaria	4	2	2	8	0.018
Nemertea	8	0	0	0	0
Other		1	1	0	0.009
Subtotal Other			6	30	0.054

TOTALS	112	417	1

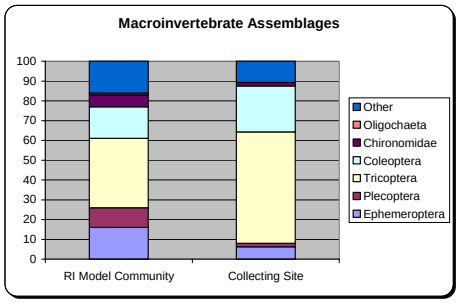
Organism Density/Sample Unit	268.8
EPT Richness	6
Total Family Richness	18
EPT/EPT+Chironomidae Ratio	0.97
Biotic Index	3.72
% Contribution of Dominant Family	31%
% Model Affinity	72%

EPT RICHNESS = RE+RP+RT	
# Ephemeroptera Families	2
# Plecoptera Families	1
# Trichoptera Families	3
EPT Richness (Total)	6

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	6%
PLECOPTERA	2%
TRICHOPTERA	56%
CHIRONOMIDAE	2%
OTHER DIPTERA	3%
COLEOPTERA	23%
ODONATA	3%
MEGALOPTERA	0%
LEPIDOPTERA	0%
AMPHIPODA	0%
ISOPODA	0%
OLIGOCHAETA	0%
GASTROPODA	2%
PELECYPODA	0%
OTHER	4%

Ephemeroptera	16	6
Plecoptera	10	2
Tricoptera	35	56
Coleoptera	16	23
Chironomidae	6	2
Oligochaeta	1	0
Other	16	11



Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: Below Barberville Dam
River/Stream/Town: Wood River, Hopkinton/ Richmond, RI
Date Sampled: 7/11/2005
Name(s): Poyer, Hetu
Date of Lab Work: 7/12/2005 V4/25/06

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12

Replicate # 1

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\overline{D}$	T x $\overline{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	11	11	44	0.11
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythidae	4	0	0	0	0
Other		3	3	0	0.03
		0	0	0	0
Subtotal E			14	44	0.14
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	6	6	6	0.06
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	0	0	0	0
Perlidae	1	12	12	12	0.12
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			18	18	0.18
MEGALOPTERA (M)					
Corydalidae	0	3	3	0	0.03
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			3	0	0.03
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	11	11	44	0.11
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			11	44	0.11
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			0	0	0
AMPHIPODA (A)					
Crangonyctidae	6	0	0	0	0
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			0	0	0

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	2
# Plecoptera Families	2
# Trichoptera Families	4
EPT Richness (Total)	8

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

Replicate # 1

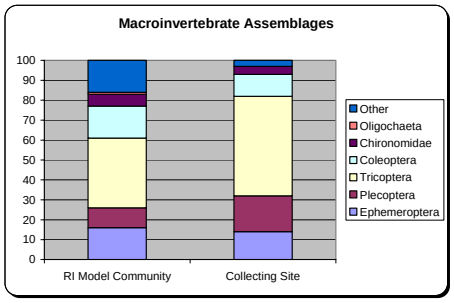
I	II	III	IV	V	VI
Families in Major Groups	T	D	$\overline{D}$	T x $\overline{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	2	2	2	0.02
Glossosomatidae	0	6	6	0	0.06
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	38	38	152	0.38
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	0	0	0	0
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	4	4	12	0.04
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal T			50	166	0.5
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	4	4	24	0.04
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			4	24	0.04
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	0	0	0	0
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	0	0	0	0
Nemertea	8	0	0	0	0
Other		0	0	0	0
Subtotal Other			0	0	0

TOTALS		100	296	1

Organism Density/Sample Unit	240
EPT Richness	8
Total Family Richness	11
EPT/EPT+Chironomidae Ratio	0.95
Biotic Index	2.96
% Contribution of Dominant Family	38%
% Model Affinity	77%

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	14%
PLECOPTERA	18%
TRICHOPTERA	50%
CHIRONOMIDAE	4%
OTHER DIPTERA	0%
COLEOPTERA	11%
ODONATA	0%
MEGALOPTERA	3%
LEPIDOPTERA	0%
AMPHIPODA	0%
ISOPODA	0%
OLIGOCHAETA	0%
GASTROPODA	0%
PELECYPODA	0%
OTHER	0%

Ephemeroptera	16	14
Plecoptera	10	18
Tricoptera	35	50
Coleoptera	16	11
Chironomidae	6	4
Oligochaeta	1	0
Other	16	3



Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site: below Alton Dam
River/Stream/Town: Wood River, Hopkinton/Richmond RI
Date Sampled: 8/25/2005
Name(s): Poyer, Hetu, Aube
Date of Lab Work: 8/30/2005 v10/7/05

	1	Mean
# Squares Picked	5	5
Total # Squares in Tray Grid		12
Replicate #	1	

I	II	III	IV	V	VI
Families in Major Groups	T (1)	D (2)	$\bar{D}$	T x $\bar{D}$	% (3)
EPHEMEROPTERA (E)					
Baetidae	4	0	0	0	0
Baetiscidae	4	0	0	0	0
Caenidae	7	0	0	0	0
Ephemerellidae	1	0	0	0	0
Ephemeridae	4	0	0	0	0
Heptageniidae	4	2	2	8	0.02
Leptophlebliidae	2	0	0	0	0
Metretopodidae	2	0	0	0	0
Isonychiidae	2	0	0	0	0
Polymitarcyidae	2	0	0	0	0
Potomanthidae	4	0	0	0	0
Siphlonuridae	7	0	0	0	0
Tricorythldae	4	0	0	0	0
Other		0	0	0	0
		0	0	0	0
Subtotal E			2	8	0.02
PLECOPTERA (P)					
Capniidae	3	0	0	0	0
Chloroperlidae	1	0	0	0	0
Leuctridae	0	0	0	0	0
Nemouridae	2	0	0	0	0
Peltoperlidae	2	2	2	4	0.02
Perlidae	1	0	0	0	0
Perlodidae	2	0	0	0	0
Pteronarcyidae	0	0	0	0	0
Taeniopterygidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal P			2	4	0.02
MEGALOPTERA (M)					
Corydalidae	0	0	0	0	0
Sialidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal M			0	0	0
LEPIDOPTERA (L)					
Pyralidae	5	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal L			0	0	0
COLEOPTERA (C)					
Dryopidae	5	0	0	0	0
Elmidae	4	12	12	48	0.12
Gyrinidae	4	0	0	0	0
Haliplidae	5	0	0	0	0
Psephenidae	4	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal C			12	48	0.12
ODONATA (O)					
Aeshnidae	3	0	0	0	0
Calopterygidae	5	0	0	0	0
Coenagrionidae	9	0	0	0	0
Cordulegastridae	3	0	0	0	0
Corduliidae	2	0	0	0	0
Gomphidae	1	0	0	0	0
Lestidae	9	0	0	0	0
Libellulidae	2	0	0	0	0
Macromiidae	2	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal O			0	0	0
AMPHIPODA (A)					
Crangonyctidae	6	2	2	12	0.02
Gammaridae	6	0	0	0	0
Talitridae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal A			2	12	0.02

I	II	III	IV	V	VI
Families in Major Groups	T	D	$\bar{D}$	T x $\bar{D}$	%
TRICHOPTERA (T)					
Brachycentridae	1	0	0	0	0
Glossosomatidae	0	0	0	0	0
Helicopsychidae	3	0	0	0	0
Hydropsychidae	4	64	64	256	0.64
Hydroptilidae	6	0	0	0	0
Lepidostomatidae	1	0	0	0	0
Leptoceridae	4	0	0	0	0
Limnephilidae	4	4	4	16	0.04
Molannidae	6	0	0	0	0
Odontoceridae	0	0	0	0	0
Philopotamidae	3	1	1	3	0.01
Phryganeidae	4	0	0	0	0
Polycentropodidae	6	0	0	0	0
Psychomyiidae	2	0	0	0	0
Rhyacophilidae	1	0	0	0	0
Sericostomatidae	3	0	0	0	0
		0	0	0	0
Other		3	3	0	0.03
Subtotal T			72	275	0.72
DIPTERA (D)					
Athericidae	2	0	0	0	0
Blephariceridae	0	0	0	0	0
Ceratopogonidae	6	0	0	0	0
Chironomidae	6	0	0	0	0
Tipulidae	4	0	0	0	0
Empididae	6	0	0	0	0
Simuliidae	6	0	0	0	0
Tabanidae	5	0	0	0	0
		0	0	0	0
		0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal D			0	0	0
ISOPODA (I)					
Asellidae	8	0	0	0	0
		0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
DECAPODA (I)					
Cambaridae	6	0	0	0	0
Astacidae	6	0	0	0	0
Other		0	0	0	0
Subtotal I			0	0	0
OTHER					
Oligochaeta	9	1	1	9	0.01
Hirudinea	10	0	0	0	0
Gastropoda	6	0	0	0	0
Pelecypoda	8	0	0	0	0
Turbellaria	4	8	8	32	0.08
Nemertea	8	0	0	0	0
Other		1	1	0	0.01
Subtotal Other			10	41	0.1

TOTALS		100	388	1

Organism Density/Sample Unit	240
EPT Richness	6
Total Family Richness	11
EPT/EPT+Chironomidae Ratio	1.00
Biotic Index	3.88
% Contribution of Dominant Family	64%
% Model Affinity	63%

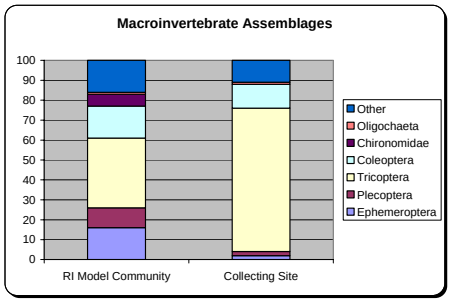
EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	1
# Plecoptera Families	1
# Trichoptera Families	4
EPT Richness (Total)	6

Codes:
(1) T = Hilsenhoff pollution tolerance- RI DEM adjusted values
(2) D = Density
(3) % = percent composition

% COMPOSITION OF MAJOR GROUPS	
EPHEMEROPTERA	2%
PLECOPTERA	2%
TRICHOPTERA	72%
CHIRONOMIDAE	0%
OTHER DIPTERA	0%
COLEOPTERA	12%
ODONATA	0%
MEGALOPTERA	0%
LEPIDOPTERA	0%
AMPHIPODA	2%
ISOPODA	0%
OLIGOCHAETA	1%
GASTROPODA	0%
PELECYPODA	0%
OTHER	9%

Ephemeroptera	16	2
Plecoptera	10	2
Tricoptera	35	72
Coleoptera	16	12
Chironomidae	6	0
Oligochaeta	1	1
Other	16	11



APPENDIX B

NYS DEC FAMILY-LEVEL MACROINVERTEBRATE INDICES

a) ***Family richness (FAMILY)****:* This is the total number of macroinvertebrate families found in a riffle kick sample. Expected ranges for 100-organism sub samples of kick samples in most streams in New York State are: greater than 13, non-impacted; 10-13, slightly impacted; 7-9, moderately impacted; less than 7, severely impacted.

b) ***Family EPT richness (EPT)****:* EPT denotes the orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). The number of EPT families found in a 100- organism sub sample is used for this index. Expected ranges from most streams in New York State are: greater than 7, non-impacted; 3-7, slightly impacted; 1-3, moderately impacted; and 0, severely impacted.

c) ***Family Biotic Index (FBI)***: The family-level Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage inputs, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each family by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). Values are listed in Hilsenhoff (1988); additional values for non-arthropods are assigned by the NYS Stream Biomonitoring Unit. The most recent values are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, nonimpacted; 4.51-5.50, slightly impacted; 5.51-7.00, moderately impacted; and 7.01-10.00, severely impacted.

d) ***Percent Model Affinity (PMA)***: This is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community based on reference stream sample. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

APPENDIX C

WATER QUALITY RATINGS

Non-impacted: Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 12 families in riffle habitats. Mayflies, stoneflies, and caddisflies are well represented; EPT family richness is greater than 7. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. 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. Family richness usually is 9-12. Mayflies and stoneflies may be restricted, with EPT values of 4-7. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. There is a slight degradation of water quality, which 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. Family richness usually is 6-8. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 1-3. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. 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 Families. Family richness is less than 6. Mayflies, stoneflies, and caddisflies are rare or absent; EPT richness is 0. The biotic index value is greater than 8.51. Percent model affinity is less than 35. 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.