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HUDSON RIVER WATERSHED
2007 BENTHIC MACROINVERTEBRATE BIOASSESSMENT

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INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a water body are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Plafkin et al. 1989, Barbour et al. 1995).

As part of the Massachusetts Department of Environmental Protection/Division of Watershed Management's (MassDEP/DWM) 2007 Hudson River Watershed assessments, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of the Hoosic River and selected tributaries and to determine their status with respect to the support of the *Aquatic Life* use, as designated in the *Massachusetts Surface Water Quality Standards* (SWQS) (MassDEP 2006). These assessments form the basis for reporting and listing waters pursuant to sections 305(b) and 303(d) of the Clean Water Act (CWA). A total of twelve biomonitoring stations were sampled to determine the health of aquatic communities in the watershed (Figure 1). Table 1 presents the 2007 sampling locations, along with station identification numbers and sampling dates. Four sites along the mainstem Hoosic River were sampled, bracketing the outfalls from the Adams Wastewater Treatment Plant (WWTP) and the Hoosac Water Pollution Control Facility (HWPCF), to determine any potential impacts to the Hoosic River from these wastewater discharges. Buxton Brook was sampled to increase the coverage of assessed waterbodies. The sampling rationale for the 2007 Hudson River Watershed macroinvertebrate survey is presented in Table 2.

To provide information for making *Aquatic Life* use-support determinations, macroinvertebrate communities present at biomonitoring stations in the Hudson River Watershed were compared with communities occurring at a regional reference station most representative of "least disturbed" conditions in the watershed. The watershed reference station (PB00) was established on Pecks Brook. This station has been used in previous biomonitoring surveys (Nuzzo 2006). Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low total taxa richness; or shifts in community composition relative to the reference station (Plafkin et al. 1989).

METHODS

Macroinvertebrate Sampling - RBPIII

Macroinvertebrate sampling and habitat assessments were conducted from August 7 – 9 at twelve sites in the Hudson River Watershed (Table 1). Sampling activities were performed in accordance with the Sampling & Analysis Plan (SAP) for the Hudson River Watershed (Reardon 2007). The sampling procedures are described in the standard operating procedures *Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates* (Nuzzo 2003), and are based on US EPA Rapid Bioassessment Protocols (RBPs) for wadeable streams and rivers (Plafkin et al. 1989). The macroinvertebrate collection procedure utilized kick-sampling, a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms in a net as the current carries them downstream. Sampling was conducted by MassDEP/DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and rocky (cobble, pebble, and gravel) substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were labeled and preserved in the field with denatured 95% ethanol, then brought to the MassDEP/DWM lab for further processing.

Macroinvertebrate Sample Processing and Data Analysis

The macroinvertebrate sample processing and analysis procedures employed for the 2007 Hudson River watershed biomonitoring samples are described in the standard operating procedures (Nuzzo 2003). Macroinvertebrate sample processing entailed distributing whole samples in pans, randomly selecting grids within the pans, and sorting specimens from the other materials in the sample until approximately

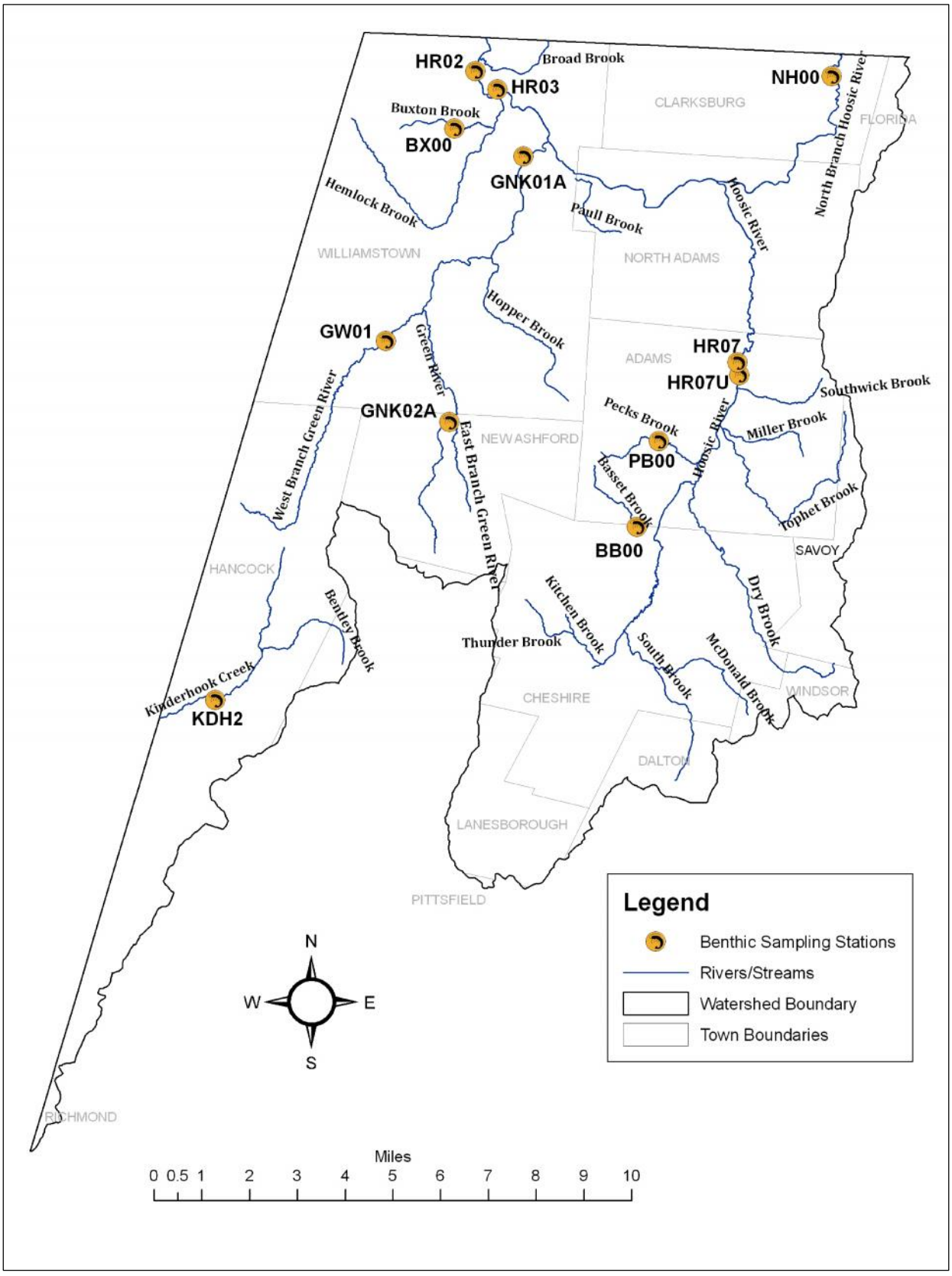

Figure 1: Hudson River Watershed Biomonitoring Stations

Table 1. List of biomonitoring stations sampled during the 2007 Hudson River Watershed survey, including station and unique identification numbers, drainage areas, sampling site descriptions, and sampling dates.

Station ID	Unique ID	Drainage Area (mi^2)	Waterbody Name	Site Description	Sampling Date
BB00	B0037	2.8	Bassett Brook	Northwest/upstream of Mason Road, upstream of gas pipeline crossing, Cheshire, MA	7-Aug-2007
PB00	B0498	2.1	Pecks Brook	~300m upstream from powerlines (north of West Mountain Road) Adams, MA	7-Aug-2007
HR07U	B0039	63.5	Hoosic River	Upstream/south of Adams WWTP discharge, Adams, MA	7-Aug-2007
HR07	B0040	64.0	Hoosic River	Downstream/north of Adams WWTP discharge, Adams, MA	7-Aug-2007
NH00	B0258	28.5	North Branch Hoosic River	~100m upstream/northwest from Henderson Road, Clarksburg, MA	7-Aug-2007
GNK02A	B0499	6.7	Green River	~100m upstream from Roys Road, New Ashford, MA	8-Aug-2007
GW01	B0036	13.0	West Branch Green River	Upstream/south of Old Mill Road, Williamstown, MA	8-Aug-2007
GNK01A	B0034	42.6	Green River	Upstream/west of Route 2 and USGS gaging station, Williamstown, MA	9-Aug-2007
BX00	B0623	2.8	Buxton Brook	~90m downstream/south from the Petersburg Road crossing nearest Northwest Hill Road, Williamstown, MA	9-Aug-2007
HR03	B0041	179	Hoosic River	~300m upstream/east from Hoosac Valley WPCF discharge, Williamstown, MA	8-Aug-2007
HR02	B0626	193	Hoosic River	~1000m downstream/northwest from Hemlock Brook and ~1200m downstream/northwest from Hoosac WPCF discharge (MA0100510), Williamstown, MA	8-Aug-2007
KDH2	B0622	13.1	Kinderhook Creek	Upstream/east of Route 43 crossing nearest Potter Mountain Road, Hancock, MA	9-Aug-2007

100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity.

Based on the taxonomy, various community, population, and functional parameters, or "metrics", were calculated which allow measurement of important aspects of the biological integrity of the macroinvertebrate community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated, and the deficiency of any one metric should not invalidate the entire approach (Plafkin et al. 1989). Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Plafkin et al. 1989). The modifications were: substitution of "reference site affinity" (RSA) for the Community Loss Index and elimination of the shredder/total ratio (no separate leaf-pack material was collected). The reference site affinity metric is a modification of Percent Model Affinity (Novak and Bode 1992). Instead of using the model's percentages for Oligochaeta, Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Chironomidae, and "other," these percentages were taken from the reference site data. The RSA score is then calculated as:

$$100 - \Sigma (\delta \times 0.5)$$

where δ is the difference between the reference percentage and the sample percentage for each taxonomic grouping. RSA percentages convert to RBP III scores as follows: 0 points for <35%; 2 points in

Table 2. Sampling rationale for 2007 Hudson River Watershed biomonitoring survey. Sampling rationale is detailed in the Hudson River Watershed Sampling and Analysis Plan (Reardon 2007).

Watershed Station ID	Waterbody	Sampling Rationale
BB00	Bassett Brook	Assess Aquatic Life Use – last sampled 1997
PB00	Pecks Brook	Reference station
HR07U	Hoosic River	Assess Aquatic Life Use – upstream Adams WWTP
HR07	Hoosic River	Assess Aquatic Life Use – downstream Adams WWTP
NH00	North Branch Hoosic River	Determine status as river enters state
GNK02A	Green River	Determine aquatic health – upper Green River
GW01	West Branch Green River	Assess Aquatic Life Use
GNK01A	Green River	Assess aquatic health – lower Green River
BX00	Buxton Brook	Never sampled. Expand spatial coverage of bioassessments
HR03	Hoosic River	Assess Aquatic Life Use – upstream Hoosac Water Quality District
HR02	Hoosic River	Assess Aquatic Life Use – downstream Hoosac Water Quality District
KDH2	Kinderhook Creek	Assess Aquatic Life Use – last sampled 1997

the range from 35 to 49%; 4 points for 50 to 64%; and 6 points if ≥65%. The entire suite of metrics used for the analysis was:

- Richness—the total number of different species present in the subsample plus those detected from a "large/rare" search of the whole sample (those taxa missed in subsampling);
- HBI—Hilsenhoff Biotic Index (Hilsenhoff 1982), as modified in Nuzzo (2003); the HBI is the sum of the products of each taxon's abundance and its corresponding pollution tolerance value, divided by the total count in the subsample;
- EPT—sum of richness among the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) as determined from the specimens in the subsample plus those detected in a "large/rare" search of the whole sample; these orders tend to be dominated by species generally considered to be pollution sensitive;
- $EPT_a/Chiro_a$—ratio of total abundance among EPT taxa to total abundance among Chironomidae taxa;
- SC/FC—ratio of the proportion of sample that is represented by individuals that predominantly feed by scraping to those that are primarily filter-feeders;

- % Dominant—most abundant taxon as a percent of the assemblage; >20% is generally considered hyperdominant and indicative of a stressor impact;

- RSA—reference site affinity (described above).

Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for the selected "least-impacted" reference station yielded an impairment score for each site. RBP III analysis separates sites into four categories: "non-impaired", "slightly impaired", "moderately impaired", and "severely impaired". Each impairment category corresponds to a specific *Aquatic Life* use-support determination used in the CWA Section 305(b) water quality reporting process—non-impaired and slightly impaired benthic invertebrate communities are generally indicative of conditions supporting the *Aquatic Life* use, whereas water bodies exhibiting moderately or severely impaired communities are generally assessed as "non-support."

Habitat Assessment

Habitat qualities were scored for each sampling reach using the assessment procedure in Plafkin et al. (1989), as modified in Barbour et al. (1999). An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Plafkin et al. 1989). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). The matrix used to assess habitat quality is based on key physical characteristics of the water body and the immediate riverfront area. Most parameters evaluated are instream physical attributes that are potential sources of limitation to the aquatic biota (Plafkin et al. 1989). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to the reference station to infer the extent to which the condition of the habitat, rather than water quality effects, may account for differences in macroinvertebrate community structure at the study sites.

RESULTS AND DISCUSSION

The quality of the habitat encountered at the biomonitoring stations in the Hudson watershed ranged from 65-85% of the maximum attainable value (Table 3). While a number of variables limited habitat throughout the watershed, channel flow status scored poorly at the majority of stations. Furthermore, the habitat at several sampling sites was deficient in one or more of the riparian parameters (i.e., bank stability, bank vegetative protection and riparian vegetative zone width).

A taxonomic list of the macroinvertebrate organisms collected at each sampling station during the 2007 biomonitoring survey is attached as an Appendix. Included in the list are total organism counts, the functional feeding group designation (FG) for each macroinvertebrate taxon, and the tolerance value (TV) of each taxon. Table 4 presents a summary of the RBP III macroinvertebrate data analyses for all sites using Peck's Brook as a regional reference site. Included are biological metric calculations, metric scores, and impairment designations.

The benthic macroinvertebrate community at Station PB00 (Peck's Brook) received the highest metric score, supporting its designation as the reference condition (Table 4). This site exhibited good taxa richness, a good EPT index and a low HBI index indicative of excellent water quality. It is important to note that 27 specimens of *Epeorus sp*, a mayfly characterized in the scraper functional feeding group, were found at this site. Due to the high number of these mayflies found, the reference station had a high scraper/filterer ratio and, consequently, most of the stations fared poorly when compared to the reference station in terms of the scraper/filterer metric.

Table 3. Habitat assessment summary for biomonitoring stations sampled during the 2007 Hudson River Watershed survey. For within-reach parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For riparian parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Maximum habitat score for any site = 200. Refer to Table 1 for a listing and description of sampling stations.

STATION	BB00	PB00[1]	HR07U	HR07	NH00	GNK02A	GW01	GNK01A	BX00	HR03	HR02	KDH2
WITHIN-REACH PARAMETERS (range is 0-20)	**SCORE**											
INSTREAM COVER	16	11	6	7	18	11	18	19	16	19	16	12
EPIFAUNAL SUBSTRATE	19	18	18	16	18	19	17	18	18	17	18	19
EMBEDDEDNESS	19	19	14	12	19	19	18	17	19	13	13	19
CHANNEL ALTERATION	20	20	12	12	17	5	20	18	16	19	19	20
SEDIMENT DEPOSITION	18	19	15	7	17	18	12	8	8	15	16	18
VELOCITY-DEPTH COMBINATIONS	16	10	16	17	15	7	14	19	10	20	19	10
CHANNEL FLOW STATUS	9	9	9	15	11	15	9	15	6	15	15	8
RIPARIAN PARAMETERS (range is 0-10 for each bank)	**SCORE**											
BANK VEGETATIVE PROTECTION left	9	9	10	10	4	10	9	5	10	3	9	10
BANK VEGETATIVE PROTECTION right	8	8	9	10	4	10	9	10	4	7	10	10
BANK STABILITY left	8	10	10	4	6	10	5	2	10	2	7	7
BANK STABILITY right	8	8	6	10	6	10	4	10	1	7	8	9
RIPARIAN VEGETATIVE ZONE WIDTH left	10	10	2	10	5	2	10	8	2	7	10	9
RIPARIAN VEGETATIVE ZONE WIDTH right	10	9	10	4	3	10	10	9	10	8	10	3
TOTAL SCORE	**170**	**160**	**137**	**134**	**143**	**146**	**155**	**158**	**130**	**152**	**170**	**154**

[1] Reference station

The macroinvertebrate communities present at the majority of the sampling stations ranged from 60%-75% comparable to the reference community, resulting in assessments of "Slightly Impacted". The macroinvertebrate community in Bassett Brook (Station BB00) was 55% comparable to the reference community and was also characterized as "Slightly Impacted". Nonetheless, approximately 30% of the invertebrate specimens collected from this stream were *Polypedilum aviceps*, a chironomid (midge) that has been associated with "clean water" conditions (Riva-Murray *et al.* 2002).

RBPIII metrics were also calculated for the sampling stations downstream from the two wastewater discharges on the main stem Hoosic River using the upstream sites as reference (Table 5). The Hoosic River upstream from the Adams WWTP (Station HR07U), when compared to the regional reference station (PB00), was considered "Slightly Impacted". The site had an elevated HBI score when compared to the reference station. This site was used as an upstream bracket on the Adams WWTP discharge. Approximately 40% of the community at this station consisted of filtering-collector taxa which, along with the elevated HBI, are indicative of organic enrichment.

Table 4. Summary of RBP III analysis of macroinvertebrate communities sampled during the 2007 Hudson River Watershed survey. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (PB00-Pecks Brook), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a listing and description of sampling stations.

SAMPLING STATION	BB00		PB00[1]		HR07U		HR07		NH00		GNK02A		GW01		GNK01A		BX00		HR03		HR02		KDH2	
STREAM	Bassett Brook		Pecks Brook		Hoosic River-		Hoosic River-		North Branch Hoosic River		Green River		West Branch Green River		Green River		Buxton Brook-		Hoosic River		Hoosic River		Kinderhook Creek	
HABITAT SCORE	170		160		137		134		143		146		155		158		130		152		170		154	
TAXA RICHNESS	23	6	24	6	33	6	26	6	32	6	17	4	31	6	31	6	29	6	28	6	26	6	16	4
BIOTIC INDEX	3.50	2	2.28	6	4.36	2	4.32	2	4.35	2	4.50	2	4.21	2	4.68	0	3.40	2	4.78	0	4.86	0	4.84	0
EPT INDEX	9	4	10	6	11	6	9	4	14	6	7	2	12	6	10	6	16	6	11	6	10	6	6	0
EPT/CHIRONOMIDAE	1.00	2	3.50	6	2.36	4	2.53	4	0.52	0	1.43	2	0.88	2	0.55	0	2.28	4	1.06	2	2.71	6	1.44	2
SCRAPER/FILTERER	0.23	0	2.21	6	0.55	2	0.50	2	0.38	0	0.02	0	0.42	2	0.78	4	0.43	2	1.13	6	0.31	0	0.13	0
REFERENCE AFFINITY	55%	4	100%	6	61%	4	67%	6	56%	4	58%	4	59%	4	59%	4	62%	4	57%	4	58%	4	58%	4
% DOMINANT TAXON	29%	4	27%	4	25%	4	14%	6	16%	6	44%	0	17%	6	13%	6	17%	6	14%	6	30%	2	50%	0
TOTAL METRIC SCORE	*22*		*40*		*28*		*30*		*24*		*14*		*28*		*26*		*30*		*30*		*24*		*10*	
% COMPARABILITY TO REFERENCE	55%		100%		70%		75%		60%		35%		70%		65%		75%		75%		60%		25%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	Slightly Impacted		Reference Condition		Slightly Impacted		Slightly Impacted		Slightly Impacted		Moderately Impacted		Slightly Impacted		Slightly Impacted		Slightly Impacted		Slightly Impacted		Slightly Impacted		Moderately Impacted	

[1] Reference station

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Table 5. Summary of RBPIII data analysis for macroinvertebrate communities sampled during the Hudson River Watershed survey on 7 and 8 August 2007. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (HR07U; HR03), and the corresponding assessment designation for each test station (HR07; HR02). Stations HR07U and HR07 bracket the Adams WWTP discharge; stations HR03 and HR02 bracket the Hoosac WPCF discharge.

SAMPLING STATION	HR07U		HR07		HR03		HR02	
STREAM	Hoosic River		Hoosic River		Hoosic River		Hoosic River	
HABITAT SCORE	137		134		152		170	
TAXA RICHNESS	33	6	26	4	28	6	26	6
BIOTIC INDEX	4.36	6	4.32	6	4.78	6	4.86	6
EPT INDEX	11	6	9	4	11	6	10	6
EPT/CHIRONOMIDAE	2.36	6	2.53	6	1.06	6	2.71	6
SCRAPER/FILTERER	0.55	6	0.50	6	1.13	6	0.31	2
REFERENCE AFFINITY	100%	6	67%	6	100%	6	74%	6
% DOMINANT TAXON	25%	4	14%	6	14%	6	30%	2
TOTAL METRIC SCORE	*40*		*38*		*42*		*34*	
% COMPARABILITY TO REFERENCE	--		95%		--		81%	
BIOLOGICAL CONDITION -DEGREE IMPACTED	Reference Condition		Non-impacted		Reference Condition		Non- to Slightly Impacted	

The benthic community downstream from the Adams WWTP (Station HR07) was composed of approximately 23% filtering-collector taxa and had a lower percent dominant taxon metric than the upstream site. Nonetheless, most of the individual metrics (e.g., HBI), as well as the total metric scores, were comparable and both sites were considered “Slightly Iimpacted” when compared to the regional reference station (PB00). When compared to the upstream Hoosic River station (HR07U), this site received an assessment of “Non-impacted” (Table 5). The structure of the Hoosic River benthic community above and below the Adams WWTP is similar to that found during previous macroinvertebrate sampling in 2002 (Nuzzo 2006). Results indicate that the effluent discharge from the treatment plant is not causing additional impacts to this portion of the river.

The Hoosic River was also sampled upstream and downstream from the effluent discharge of the Hoosac Water Quality District’s water pollution control facility (WPCF) in Williamstown (Station HR03 and HR02,

respectively). The macroinvertebrate community in the Hoosic River upstream from the WPCF (HR03) was "Slightly Impacted" when compared to that of the regional reference station on Pecks Brook. The HBI score at this station was elevated and approximately 30% of the benthic community consisted of filtering-collector taxa, primarily representatives of the caddisfly Family Hydropsychidae.

The Hoosic River downstream from the WPCF (Station HR02) was considered "Slightly Impacted" when compared to the regional reference station (PB00). This station was characterized by an elevated HBI score and exhibited a higher percent dominant taxa metric (30%) than the upstream Hoosic River station (HR03). This site was also characterized by 48% filtering-collector taxa. The *Hydropsyche morosa* group, often found in areas with high amounts of suspended sediments, occurred in high numbers. The benthic community at this station was considered "Non-impacted/Slightly Impacted" when using the upstream Hoosic River station (HR03) as the reference (Table 5).

The benthic invertebrate community at the upstream Green River sampling site in New Ashford (GNK02A) was only 35% comparable to the reference community, resulting in an assessment of "Moderately Impacted". The macronivertebrate community was dominated by black fly larvae (*Simulium sp*.) which made up 44% of the sample. The benthic community was also characterized by a high HBI score and lower taxa richness when compared to the reference station. The habitat metrics at this site generally scored well with the exception of channelization, velocity-depth combinations and riparian zone width which scored poorly on one bank. Previous benthic invertebrate sampling indicated a slightly to moderately impacted benthic community, thought to be due to low water conditions (O'Brien-Clayton, 2006). The subwatershed which includes this station is characterized by a low human disturbance gradient (HDI) with low impervious cover and limited flow alteration (Meek 2012). The agricultural landuse within the local stream corridor for the watershed that includes this station was 7.2% (Meek 2012). Non-point source pollution appears to have impacted this station.

Kinderhook Creek (KDH2) was only 25% comparable to the reference station resulting in a "Moderately Impacted" bioassessment. The macroinvertebrate community exhibited low taxa richness, high HBI and a very elevated % dominant taxon metric when compared to the reference station. The macroninvertebrate community was dominated by larvae of the black fly, *Simulium sp*., which comprised 50% of the sample. The habitat metrics at this site generally scored well with the exception of channel flow status, velocity-depth combinations and riparian vegetative zone width which scored poorly on one bank.

The benthic community of Kinderhook Creek was previously sampled in 1997 and found to be moderately impaired (Nuzzo 1999). No improvement is indicated from the 2007 benthic community assessment. The local land-use within a defined subwatershed that includes this station is 14% agricultural (Meek 2012). Water use at Jiminy Peak, upstream of this station, may have some effect on the benthic community, but previous work indicated impacted conditions both above and below the Jiminy Peak water withdrawal (Nuzzo 1999). It would appear that both non-point source pollution and habitat limitations structure the benthic community in Kinderhook Creek.

SUMMARY AND RECOMMENDATIONS

Sampling of the benthic macroinvertebrate community was carried out at twelve sites in the Hudson River Watershed in August 2007 to evaluate the biological health of selected streams and to determine their status with respect to the support of the *Aquatic Life* use. Results of these assessments form the basis for reporting and listing waters under sections 305(b) and 303(d) of the Clean Water Act. In addition, some sites were chosen to evaluate the potential effects of particular activities within their watersheds. Field and laboratory methods and data analysis were based on the USEPA's Rapid Biomonitoring Protocols.

Station PB00 on Pecks Brook, served as the reference site. The majority of water bodies were slightly impacted and these waters were considered to be supporting the *Aquatic Life Use.* The Hoosic River was sampled above and below the Adams WWTP and exhibited no pronounced difference in the benthic communities. The high HBI and dominance of filtering-collector taxa upstream from the Adams WWTP

(Station HR07U) indicate a benthic community structured in response to impacts from upstream agricultural and urban areas.

The Hoosic River stations above and below the Hoosac Water Quality District's water pollution control facility (WPCF) were comparable. The benthic community in the Hoosic River at both stations HR03 and HR02 was characterized by filter-feeding caddisflies and high HBI scores. When compared to the regional reference station on Pecks Brook, both sites were only "Slightly Impaired". When the downstream station was compared to the upstream station it should be noted that it was considered "Non-impacted/Slightly impacted". The high numbers of filter feeding caddisflies at the downstream station indicated a community structured in response to loadings of suspended organic matter. More recent macroinvertebrate sampling in 2009 by the Hoosic River Watershed Association (Hoorwa) revealed similar elevated HBI scores and similiar benthic communities at stations both above and below the WPCF (Nolan 2010). The benthic community at stations sampled by Hoorwa lacked the high number of filter feeding caddisflies seen in earlier DWM sampling, but approximately 20% of the benthic community was composed of *Cricotopus/Orthocladius* larvae (Nolan 2010). These tolerant chironomids (midges) are often found in stressed water quality conditions (Nuzzo, personal communication).

The Green River in New Ashford (Station GNK02A) exhibited a moderately impacted benthic community. This site should be sampled in any future targeted macroinvertebrate sampling to confirm aquatic life use impairment. It is believed that agricultural impacts and other non-point pollution sources may be limiting the benthic community in this reach of the Green River.

Kinderhook Creek (KDH2) had a moderately impacted benthic community and shows a lack of improvement from its last sampling. This waterbody should remain on the CWA Section 303(d) List of Impaired Waters and should be assessed as "impaired" during the next water quality assessment process.

LITERATURE CITED

Barbour, M. T., J. Gerritsen, B. D. Snyder and J. B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, DC.

Barbour, M. T., J. B. Stribling, and J. R. Carr. 1995. The multimetric approach for establishing biocriteria and measuring biological condition. pp. 63-80. *in* W. S. Davis and T. P. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL. 415 p.

Hilsenhoff, W. L. 1982. Using a Biotic Index to Evaluate Water Quality in Streams. Technical Bulletin No. 132. Department of Natural Resources, Madison, WI.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. Special Publication 5. Illinois Natural History Survey. Champaign, IL. 28 p.

MassDEP. 2006. Massachusetts Surface Water Quality Standards. (Revision of 314 CMR 4.00, effective December 29, 2006). Massachusetts Department of Environmental Protection. Boston, MA. 114 p.

Meek, J. 2012. Human Disturbance Index (Electronic Resource). Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Novak, M. A. and R. W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. J. N. Am. Benthol. Soc., 11(4): 80-110.

Nolan, J.K. 2010. Hoosic River Watershed: 2009 Stream Biomonitoring Results. Hoosic River Watershed Association, Williamstown, MA.

Nuzzo, R. M. 1999. Hudson River Watershed (Kinderhook Creek and Hoosic River Subwastersheds) 1997 Biological Assessments. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Nuzzo, R. M. 2003. CN 39.2. Standard Operating Procedures: Water Quality Monitoring in Streams Using Aquatic Macroinvertebrates. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA. 35 p.

Nuzzo, R. M. 2006. CN 193.0 Hudson Watershed 2002 Biological Assessment. Technical Memorandum TM11-7. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

O'Brien-Clayton, K. A. 2006. CN 139.5. Hudson River Watershed 2002 Water Quality Assessment Report. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross and R. M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/444/4-89-001. Assessment and Watershed Protection Division, U.S. Environmental Protection Agency, Washington, DC.

Reardon, M. 2007. CN 287.0 Sampling Plan for Year 2007 Surface Water Monitoring in the Hudson Watershed. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA

Riva-Murray, K. R.W. Bode. P.J. Phillips and G.L. Wall. 2002. Impact Source Determination with Biomonitoring Data in New York State: Concordance with Environmental Data. Northeastern Naturalist. Vol. 9 (2): 127-162.

US EPA. 1995. Generic Quality Assurance Project Plan Guidance for Programs Using Community Level Biological Assessment in Wadeable Streams and Rivers. U.S. Environmental Protection Agency, Office of Water. 71 p.

APPENDIX

Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected from stream sites during the 2007 Hudson River Watershed survey on 7 - 9 August 2007. Refer to Table 1 for a listing and description of sampling stations.

TAXON	FFG[1]	TV[2]	Sampling Stations											
			BB00	PB00[3]	HR07U	HR07	NH00	GNK02A	GW01	GNK01A	BX00	HR03	HR02	KDH2
Nais sp.	GC	8								2				
Nais behningi	GC	6								1				
Tubificidae	GC	10							1					
Lumbriculidae	GC	7	1		2					2			1	1
Trombidiformes	PR	6							1					
Sperchon sp.	PR	6			2	8		1		2		4	3	
Torrenticolidae	PR	6		1										
Torrenticola sp.	PR	6						3						
Baetidae	GC	4		1			1		1		1			
Acentrella turbida	SC	4			1					4				
Baetis sp.	GC	6			2	7	2	2		1		4	4	3
Baetis flavistriga	GC	4		1	1	6		1	1			3	3	
Baetis intercalaris	GC	6								5		1	3	
Baetis tricaudatus	GC	6	10	7	1	3	4	11	3	2	2	2		16
Diphetor hageni	GC	6						3			2			
Plauditus sp.	GC	4			1	1				2				
Drunella lata	SC	0		4										2
Ephemerella sp.	GC	1			3	5				2		2	3	
Serratella sp.	GC	2										1		
Heptageniidae	SC	4					2		1		1	1	1	
Epeorus sp.	SC	0	5	27					1					
Epeorus vitreus	SC	0									1			
Maccaffertium sp.	SC	3			5	2				1				
Isonychia bicolor	FC	2											1	
Paraleptophlebia sp.	GC	1						1	2					
Paraleptophlebia guttata	GC	1									1			
Boyeria vinosa	PR	2							1					
Gomphidae	PR	5		1										
Lanthus sp.	PR	5							1					
Sweltsa sp.	PR	0	5	10	1		1				2			
Leuctra sp.	SH	0	2				2	4			2			2
Tallaperla maria	SH	0		1							3			
Agnetina capitata	PR	2					1		3		1			
Paragnetina immarginata	PR	1				1	1							
Paragnetina media	PR	5			1									
Perlodidae	PR	2							1					
Diura sp.	PR	2		2							1			
Pteronarcys proteus	SH	0		2					1		2			
Nigronia serricornis	PR	0					1							
Trichoptera		4	1											
Apatania sp.	SC	3		1										
Brachycentrus sp.	FC	1												2
Glossosomatidae	SC	0								1				
Glossosoma sp.	SC	0				1	1				5			
Protoptila sp.	SC	1							1					
Helicopsyche borealis	SC	3										1		
Hydropsychidae	FC	4									4			
Cheumatopsyche sp.	FC	5					1			1	2	4	4	
Hydropsyche sp.	FC	4			25	7	5	3	6		5		5	
Hydropsyche morosa	FC	6			10	7	1		1	2		14		
Hydropsyche morosa gr.	FC	6											30	
Hydropsyche sparna	FC	6	6			3	3		3		12			
Leucotrichia sp.	SC	6										1		

TAXON	FFG[1]	TV[2]	Sampling Stations											
			BB00	PB00[3]	HR07U	HR07	NH00	GNK02A	GW01	GNK01A	BX00	HR03	HR02	KDH2
Lepidostoma sp.	SH	1	1											
Goera sp.	SC	3							1					
Chimarra socia	FC	2										1	1	
Dolophilodes distinctus	FC	0	14	7			2	5	4		7			
Polycentropodidae	FC	6	1											
Psychomyia sp.	GC	2											1	
Rhyacophila sp.	PR	1									3		1	
Rhyacophila carolina gr.	PR	1	1											
Rhyacophila fuscula	PR	0					1							1
Neophylax concinnus	SC	3			1					1				
Elmidae	SC	4										3		
Optioservus sp.	SC	4											8	
Optioservus ovalis	SC	4		1	10				7	13	5			4
Optioservus trivittatus	SC	4				6	2					15		
Oulimnius latiusculus	SC	4	1	9		1		1	4		4			2
Promoresia tardella	SC	2			1	1	6							
Stenelmis sp.	SC	5			3		1			1			5	
Stenelmis crenata	SC	5							1			10		
Psephenus herricki	SC	4			1	1	1					3	1	
Atherix sp.	PR	4			2	14				4				
Blepharicera sp.	SC	0	1											
Atrichopogon sp.	PR	6									1			
Microtendipes pedellus gr.	FC	6				1						6	2	
Polypedilum aviceps	SH	4	29	1	9	6	16	16	14	12	18		1	2
Polypedilum flavum	SH	6							2	1		3	5	
Polypedilum halterale gr.	SH	6										1		
Polypedilum illinoense gr.	SH	6	1		1			1						
Polypedilum scalaenum gr.	SH	6			1									
Tanytarsini	FC	6					2							
Cladotanytarsus sp.	FC	5							1			1		
Micropsectra sp.	GC	7					1		1			2		
Micropsectra/Tanytarsus sp.	FC	7												2
Rheotanytarsus exiguus gr.	FC	6			1		9			6	1			
Rheotanytarsus pellucidus	FC	5			2	1								
Stempellinella sp.	GC	2	1					1	2	1				
Sublettea coffmani	FC	4								7		4	5	
Tanytarsus sp.	FC	6	4	11		1	9	1	6	2	1			7
Diamesa sp.	GC	5												1
Pagastia sp.	GC	1				2	1						1	
Potthastia gaedii gr.	GC	2			1					1		6	2	
Potthastia longimana gr.	GC	2			1									
Orthocladiinae	GC	5										1		
Brillia sp.	SH	5		1				1						
Cardiocladius sp.	PR	5										1		
Cardiocladius albiplumus	PR	5											2	
Cardiocladius obscurus	PR	5								1				
Corynoneura sp.	GC	4		1										
Cricotopus tremulus	SH	7											1	
Cricotopus/Orthocladius sp.	GC	7										3	1	
Eukiefferiella brehmi gr.	GC	4				1								
Eukiefferiella claripennis gr.	GC	8	1											
Eukiefferiella devonica gr.	GC	4												1
Orthocladius sp.	GC	6			1									
Parachaetocladius sp.	GC	2	1								1			2
Parametriocnemus sp.	GC	5	5	2	3	4	8		7	6	3	2	1	3
Psilometriocnemus sp.	GC	4		1										
Rheocricotopus sp.	GC	6	1	1						2				
Tvetenia sp.	GC	5					1							
Tvetenia paucunca	GC	5	1			1	2				1			

TAXON	FFG[1]	TV[2]	Sampling Stations											
			BB00	PB00[3]	HR07U	HR07	NH00	GNK02A	GW01	GNK01A	BX00	HR03	HR02	KDH2
Tvetenia vitracies	GC	5			1		3							
Thienemannimyia gr.	PR	6	2		1		2	1	1	1		3		
Hemerodromia sp.	PR	6			1	1	1		1	2				
Neoplasta sp.	PR	6			1						1			
Simulium sp.	FC	5	5	1	2	4	2	44	17	9	5			51
Antocha sp.	GC	3			1	7				2		4	4	
Dicranota sp.	PR	3		4			1		1		5	1		
Hexatoma sp.	PR	2		2					1		1			
TOTAL			**100**	**100**	**100**	**103**	**97**	**100**	**100**	**100**	**104**	**108**	**100**	**102**

[1]Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: SH-Shredder; GC-Gathering Collector; FC-Filtering Collector; SC-Scraper; PR-Predator.

[2]Tolerance Value (TV) is an assigned value used in the calculation of the Biotic Index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for very tolerant organisms.

[3] Reference station