Assessment of Benthic Macroinvertebrate Communities in the Presque Isle Bay Watershed

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By

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INTRODUCTION AND GOALS

Presque Isle Bay, at the northwestern corner of Pennsylvania on Lake Erie, has recently been the focus of intense study aimed at determining the amounts and sources of contaminants found in its bottom sediments. Major point-sources or pollutants, including combined sewer overflows from the City of Erie, have largely been eliminated. However, non-point source pollution (NPSP) in the watershed continues to contribute contaminants to the system. Substances originating in runoff from streets, parking lots and lawns, materials eroded from unstable stream-banks during high flows, and airborne contaminants carried to the ground by precipitation, may all enter the bay via major streams, especially during storm events. For these reasons, assessment of the condition of the major streams that flow into Presque Isle Bay was judged to be a an important initial step in planning for NPSP abatement in the watershed.

The assessment of the PIB watershed focused on three different attributes known to be indicative of stream degradation: 1) habitat and physicochemical factors, 2) fish communities, and 3) benthic macroinvertebrate communities. It is assumed that a comparative analysis of habitat and biological condition among sites and streams will provide an objective basis for identifying locations within the watershed where remediation may be needed. This report focuses on the benthic macroinvertebrate analyses conducted by Mercyhurst College. The results include quantitative and qualitative descriptors of the biological condition of stream reaches at key locations within the watershed, and should provide a baseline for monitoring the expected future

recovery of biological communities consequent to the implementation of a watershed restoration plan.

METHODS

Sampling Sites for Benthic Macroinvertebrate Assessment

Assessment of benthic macroinvertebrate communities was conducted on a seasonal basis for each of the perennial streams that flow into Presque Isle Bay (PIB) plus several reference sites in Lake Erie tributaries outside of the Presque Isle Bay watershed. Sample site selection was coordinated with Mr. Bob Wellington of the Erie County Health Department. A total of eight sites were sampled repeatedly on Mill Creek, which drains the largest portion of the PIB watershed (Figure 1). Six sites were sampled on multiple dates on Cascade Creek, and one site was sampled on each of Scott and Garrison Runs, at the extreme western and eastern portions of the PIB watershed, respectively. Two reference sites on Sevenmile Creek, and one on Twelvemile Creek were also sampled on multiple dates (Figure 2). The stream-order at the sampled sites, and exact dates of sampling are summarized in Table 1. Most of these sites were also sampled on slightly different dates for fish (by Penn State researchers) and habitat/physico-chemical condition (by Gannon researchers).

A number of additional reference sites within and outside the PIB watershed were sampled during various times of the year (especially during the Fall of 2001), in order to provide data necessary for conducting the final analysis of sample metrics (described in the next section of the report). Most of the additional reference sites were selected at locations thought to be minimally impacted by NPSP: i.e. less developed areas within the

Lake Erie watershed. In addition to the primary reference sites RF1 and RF3 (Table 1), "unimpacted" reference sites include all sites denoted with an asterisk in Appendix A.

Benthic Macroinvertebrate Sampling and Analysis Protocols

Sampling for benthic macroinvertebrates was carried out using the methodology of EPA's (1999) Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (2^{nd} ed.) -- "Multihabitat Approach: D-Frame Net" (Section 7.2). For each site, a 100-m reach representative of the characteristics of the stream was selected, upstream from road crossings, and the relative abundance of various habitats (riffle, run, pool) was estimated. Then multiple kick samples were taken and combined into a single sample while moving from the downstream to upstream end of the reach, using a D-Frame net with a mesh size of 500 microns.

Approximately 1 square meter of substrate on the stream bottom upstream from the mouth of the net was dislodged for each kick. In most situations, ten kick samples were taken per site, with kicks distributed among habitats in proportion to habitat abundance (e.g. if the reach contained 50% riffles, 30% runs, and 20% pools, then 5,3, and 2 kick samples were taken from each respective habitat). In the case of a few reference sites on small first order streams, the number of kicks was reduced (to a minimum of three) to reduce the risk of destructive sampling.

Large stones, leaves and pieces of woody debris were rinsed-off in the mouth of the net, and the sample was transferred to jars and preserved with a 5% formalin rose-bengal solution. Rose-bengal is a bright pink stain that facilitates distinguishing organisms

(especially small midge larvae and worms) from mineral matter and plant debris during sample sorting. In the laboratory, each sample was transferred to large shallow, white pans marked with grid lines, and organisms were picked-out with the aid of moveable table-mounted lights and magnifiers or diopters. Invertebrate animals in the samples were identified to the lowest practicable taxonomic level (to genus in the case of most aquatic insects) and counted, with the aid of a dissecting microscope. Sample data was subsequently analyzed using the "Multimetric Approach" (Section 9.1.1) of EPA's (1999) Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (2^{nd} ed.).

The first step in this analysis was to determine values for six different metrics for each sample – total number of taxa, number of EPT taxa (Ephemeroptera, Plecoptera, Trichoptera), number of intolerant taxa (taxa with PA modified Hilsenhoff Biotic Index Scores less than 6), percentage EPT, percentage intolerant, and Hilsenhoff Biotic Index. Sample metrics for all sites and dates, organized by stream order, are found in Appendices B through D. The second step in the analysis was the standardization of each metric so that the values could be scored on a range of values from 1 to 10. Metric data standardization involved compiling the metric values in separate data sets according to stream order for all sample sites, including the reference sites at locations thought to be minimally impacted by NPSP. A statistical analysis (using Microsoft Excel) was carried out for each metric and stream size-category to determine the 95 percentile value (5 percentile value in the case of the Hilsenhoff index), which was then divided by 10 to determine the increment of metric scores for each standardized value from 1 to 10. The metric values for each sample were then reassigned a score from 1 to 10, with higher

scores representing greater diversity/water quality. The scores for the six metrics per sample were then summed to determine the Composite Index score, which could range from 6, for samples in which all metric scores were 1 (a condition classified as "minimal biotic diversity"), to 60, for samples that received the top score for all six metrics (classified as "optimum condition"). Standardized metric and Composite Index scores determined for all sampled sites and dates are summarized in Appendices E through G.

The final step in the analysis was to determine the threshold composite index value for classifying the biological condition of the sites. This was done by a statistical analysis of the composite index scores of the *reference sites* alone for each stream size category. The 25 percentile value was determined and set as the score that separated "good" sites from "fair" sites for streams of each order. The remaining range of possible Composite Index scores above the 25 percentile were then divided into two equal increments ("good" and "very good"), and index scores below the 25 percentile were divided into four equal increments ("fair," "slightly degraded," "poor," and "very poor"). Composite Index scores determined for the PIB watershed and reference sites are shown in Figure 3.

This analytical approach has the powerful advantage of evaluating biological condition of "stressed" sites using unimpacted reference sites of similar-sized streams within the same region (Lake Erie watershed) as the "judges" of what sample characteristics represent good versus poor. This kind of analysis is especially important for streams in the Lake Erie watershed because of their distinctive "flashy" hydrographs and often "challenging" substrata (e.g. extensive areas of bare bedrock).

RESULTS AND DISCUSSION

General Taxonomic Analysis

Table 2 indicates occurrence of invertebrate taxa among streams, with all sites for each stream combined. Tables 3, 4, and 5 indicate abundance of invertebrates per site for first second, and third order streams, respectively, using summary descriptors based upon the actual counts in samples. A taxon was indicated as abundant (a) at a site if 100 or more individuals were counted in one or more samples from that site (on all dates). If the maximum count per sample for all dates sampled was between 10 and 100, the taxon was listed as common (c) for that site. Uncommon (u) was indicated for taxa whose maximum count was between 3 and 10 on all dates, and a descriptor of rare (r) was assigned if there were never more than 1 or 2 individuals counted in any of the samples for a site.

Representatives of four different phyla of invertebrate animals were widespread among the sampled streams (Table 2). Free-living planarian flatworms (Platyhelminthes: Planariidae) were found in all streams except Garrison Run. Nematodes were found in all streams except GR and Twelvemile Creek, although they were usually rare (Tables 3-5). A single representative of the phylum Cnidaria, the freshwater *Hydra*, was rare – found once in the primary tributary to Mill Creek at Belle Valley.

Crustacean arthropods were represented by crayfish (Decapoda – Cambaridae) in all streams except Garrison Run and Scott Run. Crayfish were always rare or uncommon,

and typically did not occur at all sites within streams (Tables 3-5). The aquatic isopod *Lirceus* was found in all streams except Garrison Run (GR) and Twelvemile Creek. The amphipod *Crangonyx* was found in all streams in the PIB watershed, but was not found at any of the primary reference sites (RF1, RF2, and RF3). Terrestrial isopods (wood lice) and millipedes, incidental in samples on some sites and dates in most streams, were almost always uncommon or rare.

Among annelids, terrestrial-type earthworms were found in low numbers in samples from nearly all sites. Aquatic oligochaetes were common or abundant at all sites and streams. Leeches (Hirudinea) were found in all streams of the PIB watershed, but not at the primary reference sites. Physid snails and the fingernail clam *Pisidium* were the most common molluscs – present in all streams except Scott Run.

Aquatic insects were the most diverse group represented in the benthic macroinvertebrate communities of the streams sampled, with 9 different orders, 51 different families, and over 100 genera identified. Insect taxa in the three orders traditionally considered intolerant of water pollution in streams: mayflies (Ephemeroptera – E), stoneflies (Plecoptera – P), and caddisflies (Trichoptera – T) encompassed more than half of the many types of insects found in Mill Creek and the two primary reference streams (Table 2). No mayflies or stoneflies were found at any of the sites on Cascade Creek, Garrison Run, or Scott Run.

About two-thirds to three-fourths of the insect taxa found at all Mill Creek sites and Sevenmile Creek at the Glinodo Center were rare or uncommon (Tables 2-4), and generally few of the EPT taxa were ever common or abundant at those locations. In contrast, only about half of the insects were rare or uncommon at the Twelvemile Creek site and the upper site on Sevenmile Creek, and many EPT taxa were common or abundant at those sites.

Most of the insects found in Cascade Creek were larvae of true flies (Diptera), an order generally considered tolerant of pollution. Among the dipterans, immature Chironomidae (midges) were the most widespread and abundant type. This family probably was represented by dozens of different species.

Comparison of Sites Within Streams

A general decline was evident in the variety of invertebrate taxa found at sites along the main stem of Mill Creek, progressing from Rt. 97 (MC5) to the site above the Erie Zoo (MC2) to the site a short distance above the entrance to the Mill Creek tube (MC1), coincident with a decline in the number of common or abundant EPT taxa (Tables 4 and 5). Similar declines were also evident between the up- and down-stream sites in Sevenmile Creek.

Along the West Branch of Cascade Creek, invertebrate variety appeared to diminish sharply between the W. 16th St. site (CC6) and the channelized reach at West Erie Plaza (CC5), although taxon variety then appeared to recover at the Harding site (CC4) and the

locations along the main stem at Frontier Park (CC2) and near the mouth (CC1) (Tables 3 and 4).

Composite Index Analysis and General Indications

For all sites sampled on multiple dates, the average values for the Composite Index scores are shown in Tables 6, 7, and 8 for first order, second order, and third order stream sites, respectively. The Composite Index scores for these sites plus the additional reference sites are represented pictorially in Figure 3. The results generally confirm the expected outcome that heavily developed portions of the PIB watershed (i.e. Garrison Run, Cascade Creek and Scott Run watersheds) have the most severely degraded benthic macroinvertebrate communities. Garrison Run contained the poorest benthic macroinvertebrate community (minimal biological diversity), Cascade Creek sites were slightly better (rated very poor), Scott Run was poor, and nearly all of the Mill Creek sites sampled on multiple dates were rated as poor or slightly degraded, with the exception of MC5, which received a rating of fair.

MC5, located east of Rt. 97 near Gore Rd., lies at he terminus of a large undeveloped valley that extends to Lake Pleasant Road. The sites which received the highest Composite scores on Mill Creek were two first order stream sites within that same valley (MCR2 and MCR3), which were sampled only once during September of 2001. One of those first order streams (MCR2) contained populations of aquatic insects (i.e. the stonefly *Peltoperla*, and caddisflies *Parapsyche* and *Wormaldia*) that occurred at few or no other locations in the Lake Erie watershed during the current study, and appear to be

indicators of relatively pristine condition. These findings, in addition to the fact that 94 taxa of aquatic insects (including 50 EPT taxa) were collectively identified at sites within the Mill Creek watershed, suggests that biological elements are in-place which could support biological recolonization of presently degraded areas of Mill Creek, both upstream and downstream of the undeveloped zone between Rt. 97 and Lake Pleasant Road. ***This underscores the critical importance of taking steps to prevent any degradation of the few undeveloped areas that remain in the watershed.***

Biological recovery of Cascade Creek, Scott Run, and Garrison Run, may be more problematic, as these streams lie in watersheds that are nearly completely developed, and which appear to currently lack populations of aquatic insects that would be necessary to support biological restoration. It is possible that populations from Mill Creek could disperse to these streams via adult flight or wind dispersal, but the portions of Mill Creek that would be in the most suitable position to provide insect colonists for these streams are presently enclosed within the Mill Creek tube. However, the fact that even limited portions of the Presque Isle Bay watershed (in the Mill Creek portion) contain residual populations of pollution-sensitive insects indicates that there is still a chance for biological recovery of the streams, if appropriate remediation of degraded stream channels, buffer zones and water source areas is undertaken.

The specific analysis of where remediation efforts can and should be initiated in the Presque Isle Bay watershed will occur concurrent with the preparation of the comprehensive final report that integrates the findings herein with the results of the

habitat/physicochemical and fish community analyses. Preliminary inspection of the Gannon study (on habitat and physicochemical analysis) indicates general agreement regarding indications of locations where the watershed is most severely degraded. The comprehensive final analysis is expected to be complete by mid-August 2002.

The views expressed herein are those of the author, Dr. J. Michael Campbell, and do not necessarily reflect the views of the PA Department of Environmental Protection.

Table 1. Sample site designations, stream order, location/descriptions, and dates sampled.

Site	Stream Order	Location	Dates sampled
		Presque Isle Bay Watershed Sites	
Mill Creek			
MC1	3	34th St.	10-10-00, 3-27-01, 6-21-01, 9-11-01
MC2	3	Above zoo S. of 41st St.	10-10-00, 11-18-00, 4-10-01, 6-21-01, 9-12-01
MC3	2	Glenridge (W. Branch)	11-18-00, 6-26-01, 9-12-01
MC4	1	Old French S. of Rt. 97 Int.	10-17-00, 5-1-01, 7-19-01, 10-5-01
MC5	2	S. of E. Gore E. of Rt. 97	10-17-00, 4-26-01, 7-17-01, 9-12-01
MC6	2	Belle Valley, S. of Norcross Rd.	10-3-00, 3-22-01, 6-21-01, 9-20-01
MC7	1	Belle Valley N. of Fire Hall	10-3-00, 6-12-01, 9-20-01
MC8	2	Headwaters Park	10-3-00, 3-22-01, 6-14-01, 9-21-01
Garrison Run			
GR	2	N. of 5th St. at Frontier Lumber	12-14-00, 5-11-01, 8-1-01, 9-28-01
Cascade Creek			
CC1	2	Near mouth of creek at Bay	12-7-00, 5-9-01, 7-20-01, 9-25-01
CC2	2	Frontier Park E. of foot-bridge	12-7-00, 5-9-01, 7-24-01, 9-25-01
CC3	2	S. of 8th St E. of Greengarden	7-27-01, 10-4-01
CC4	1	S. of Harding Elementary	12-9-00, 5-9-01, 7-27-01, 10-4-01
CC5	1	West Erie Plaza S. of Wendy's	7-27-01, 10-4-01
CC6	1	16th Street W. of Pittsburgh Ave.	12-7-00, 5-7-01, 7-26-01, 10-4-01
Scott Run			
SR	1	In ravine E. of Peninsula Drive	12-14-00, 5-7-01, 7-26-01, 10-4-01
		Primary Reference Sites	
Sevenmile Creek			
RF1	2	E. of Depot Road at Fuller home	5-11-01, 7-18-01, 10-3-01
RF2	3	Near mouth at Glinodo Center	5-1-01, 7-18-01, 10-2-01
Twelvemile Creek			
RF3	3	S. of Rte. 5	5-11-01, 7-18-01, 10-2-01, 12-20-01

Table 2. Taxa of benthic macroinvertebrates found in streams of the Presque Isle Bay watershed and at reference sites on Sevenmile and Twelvemile Creeks during 2000 and 2001. An "X" indicates the taxon was present at one or more sites.

Taxon	Mill Creek	Garrison Run	Cascade Creek	Scott Run	7-Mile Creek	12-Mile Creek
Cnidaria						
Hydra	X					
Platyhelminthes						
Planariidae	X		X	X	X	X
Nematoda	X		X	X	X	
Annelida						
Oligochaeta fw	X	X	X	X	X	X
Lumbricidae	X	X	X	X	X	X
Hirudinea type 1	X		X	X		
Hirudinea type 2	X		X			
Mollusca						
Ancylidae	X				X	X
Lymnaeidae						X
Physidae	X	X	X		X	X
Terrestrial gastropods				X		
Bivalvia Pisidium	X		X		X	X
Arthropoda - Crustacea						
Decapoda Cambaridae	X		X		X	X
Isopoda Lirceus	X		X	X	X	
Terrestrial isopod	X		X	X	X	
Amphipoda Crangonyx	X	X	X	X		
Diplopoda terrestrial	X	X	X	X		X
Arthropoda – Insecta						
Hemiptera						
Gerridae Gerris	X				X	X
Limnoporus	X					
Trepobates					X	
Mesovelidae Mesovelia	X				X	
Veliidae Microvelia	X					
Rhagovelia	X				X	
Collembola						
Isotomidae Agrenia	X		X		X	
Odonata						
Aeshnidae Aeshna	X					
Boyeria	X		X		X	
Gomphidae Stylogomphus	X					
Calopterygidae Calopteryx	X				X	
Ephemeroptera						
Baetidae Baetis	X				X	X
Centroptilum	X				X	X
Caenidae Caenis	X					X
Ephemerellidae Drunella	X				X	
Ephemerella	X					X
Eurylophella	X				X	X
Ephemeridae Ephemera	X				X	X
Heptageniidae Cinygmula					X	X
Epeorus					X	X
Leucrocuta	X				X	X
Stenonema	X				X	X

Table 2. continued

Taxon	Mill Creek	Garrison Run	Cascade Creek	Scott Run	7-Mile Creek	12-Mile Creek
Ephemeroptera						
Heptageneiidae Stenacron	X				X	X
Unid.	X					
Leptophlebiidae						
Habrophlebiodes	X				X	X
Leptophlebia	X					
Paraleptophlebia	X				X	X
Oligoneuridae Isonychia						X
Siphlonuridae Ameletus	X				X	X
Tricorythidae Tricorythodes	X				X	
Arthropoda – Insecta cont.						
Plecoptera						
Capniidae Allocapnia	X				X	X
Utacapnia	X				X	X
Unidentified	X					
Chloroperlidae Haploperla	X				X	
Suwallia	X				X	
Sweltsa	X					X
Utaperla	X				X	X
Leuctridae Leuctra	X				X	X
Nemouridae Amphinemoura	X				X	X
Peltoperlidae Peltoperla	X					
Perlidae Acroneuria					X	
Agnetina	X				X	X
Beloneuria	X				X	
Neoperla					X	
Paragnetina						X
Perlodidae Diploperla	X				X	X
Diura						X
Trichoptera						
Glossosomatidae Glossosoma	X					X
Helicopsychidae Helicopsyche	X					X
Hydropsychidae						
Cheumatopsyche	X		X		X	X
Diplectrona	X			X	X	X
Hydropsyche	X		X	X	X	X
Parapsyche	X					
Hydroptilidae Hydroptila	X		X			X
Leptoceridae	X					
Limnephilidae Apatania	X				X	
Asynarchus					X	
Hydatophylax	X					
Pseudostenophylax	X					
Philopotamidae Chimarra	X				X	X
Dolophilodes	X				X	X
Wormaldia	X					
Phryganeidae Ptilostomis	X					
Unidentified	X					
Polycentropodidae						
Neureclipsis	X				X	
Nyctiophylax	X					
Polycentropus	X				X	X
Unidentified	X					

Table 2. continued

Taxon	Mill Creek	Garrison Run	Cascade Creek	Scott Run	7-Mile Creek	12-Mile Creek
Trichoptera						
Psychomyiidae Psychomyia						X
Unidentified	X					
Rhyacophilidae Rhyacophila	X				X	X
Uenoidae Neophylax						X
Megaloptera						
Corydalidae Nigronia	X				X	X
Sialidae Sialis	X		X		X	
Coleoptera						
Dytiscidae Agabus	X			X		
Copelatus	X					
Hydroporus	X					X
Oreodytes					X	
Unidentified					X	
Elmidae Dubiraphia	X				X	X
Optioservus					X	X
Oulimnius	X				X	X
Stenelmis	X		X		X	X
Hydrophilidae Helochares				X		
Helocombus	X					
Hydrobius	X					
Psephenidae Psephenus	X				X	X
Diptera						
Ceratopogonidae Probezzia	X				X	
Chironomidae	X	X	X	X	X	X
Dixidae Dixa					X	
Dolichopodidae unid.	X		X			
Empididae Chelifera					X	
Clinocera	X				X	X
Hemerodromia	X		X		X	X
Ephydridae unid.	X					
Muscidae Limnophora			X			
Unidentified	X					
Simuliidae Simulium	X		X	X	X	X
Tabanidae Chrysops	X		X			
Unidentified	X					
Tipulidae Antocha	X		X		X	X
Dicranota	X				X	X
Helius	X					
Hexatoma	X				X	X
Limonia			X			
Limnophila	X				X	X
Lipsothrix	X					
Molophilus	X					
Pedicia	X					
Prionocera	X					
Pseudolimnophila	X					X
Tipula	X	X	X	X	X	X
Unidentified	X		X			
Total number of taxa	109	7	30	18	71	65
Total number of Insect taxa	94	2	17	8	61	56
Total number of EPT taxa	50	0	3	2	34	38

Table 3. Benthic macroinvertebrate abundance at sampling sites on first order streams. Criteria for abundance categories defined in text: a = abundant; c = common; u = uncommon; r = rare. Numbers in parentheses indicate number of dates each site was sampled.

Taxon	MC4 (4)	MC7 (3)	CC6 (4)	CC5 (4)	CC4 (2)	SR (4)
Cnidaria						
Hydra		r				
Platyhelminthes						
Planariidae	u		c	a	c	u
Nematoda	r	r			r	r
Annelida						
Oligochaeta fw	c	a	c	a	a	c
Lumbricidae	u	u	c			c
Hirudinea type 1		c	c		u	u
Hirudinea type 2		u	r			
Mollusca						
Physidae	r	u	u	r	c	
Terrestrial gastropods						r
Bivalvia Pisidium	r	u	r	c	r	
Arthropoda - Crustacea						
Decapoda Cambaridae	u	r				
Isopoda Lirceus		a	a		u	r
Terrestrial isopod	u	u	r			r
Amphipoda Crangonyx		c	a	u	c	c
Diplopoda terrestrial	u				r	c
Arthropoda – Insecta						
Hemiptera						
Gerridae Gerris	r					
Veliidae Microvelia		u				
Collembola						
Isotomidae Agrenia	r					
Odonata						
Aeshnidae Aeshna	r					
Boyeria		r			r	
Calopterygidae Calopteryx		r				
Ephemeroptera						
Baetidae Baetis	c	c				
Centroptilum	r	u				
Heptageniidae Unid.	r					
Leptophlebiidae						
Habrophlebiodes	a					
Siphlonuridae Ameletus	c					
Tricorythidae Tricorythodes						
Plecoptera						
Chloroperlidae Haploperla	c					
Perlodidae Diploperla	c	u				
Trichoptera						
Helicopsychidae Helicopsyche	r					
Hydropsychidae						
Cheumatopsyche		u				
Diplectrona	c	c				r
Hydropsyche	r	r	r		u	r
Limnephilidae Apatania	r					

Table 3. continued

Taxon	MC4 (4)	MC7 (3)	CC6 (4)	CC5 (4)	CC4 (2)	SR (4)
Trichoptera						
Phryganeidae Unidentified		r				
Polycentropodidae						
Polycentropus	u					
Psychomyiidae Unidentified	r					
Rhyacophilidae Rhyacophila	r					
Megaloptera						
Sialidae Sialis	u		r			
Coleoptera						
Dytiscidae Agabus						r
Copelatus	r					
Oreodytes						r
Elmidae Dubiraphia		c				
Oulimnius		c				
Stenelmis		a	r			
Hydrophilidae Helochares						r
Helocombus	r					
Hydrobius	r					
Diptera						
Ceratopogonidae Probezzia	r					
Chironomidae	a	a	a	u	c	c
Dolichopodidae unid.			u			
Empididae Hemerodromia			c		c	
Simuliidae Simulium	c	u	u			u
Tabanidae Chrysops	u	u				
Tipulidae Dicranota	u					
Hexatoma	r					
Limonia					u	
Molophilus	r					
Pedicia		r				
Prionocera		r				
Pseudolimnophila	c	r				
Tipula	c	u	c		u	c
Total number of taxa	39	32	18	6	15	18
Number of taxa "u" or "r"	28	22	9	3	9	12
Number of EPT taxa "a" or "c"	6	2	0	0	0	0

Table 4. Benthic macroinvertebrate abundance at sampling sites on second order streams. Criteria for abundance categories defined in text: a = abundant; c = common; u = uncommon; r = rare. Numbers in parentheses indicate number of dates each site was sampled.

Taxon	MC8 (4)	MC6 (4)	MC5 (4)	MC3 (3)	GR (4)	CC3 (2)	CC2 (4)	CC1 (4)	RF1 (3)
Platyhelminthes									
Planariidae		r	u	c		r	c	c	c
Nematoda	c	r	u			u	u		u
Annelida									
Oligochaeta fw	c	a	a	a	a	a	a	c	a
Lumbricidae	u	u	u	r	u	u	c	c	u
Hirudinea type 1			r				u	r	
Mollusca									
Ancylidae	u								
Physidae		u	u		u		r	r	c
Bivalvia Pisidium							r		c
Arthropoda - Crustacea									
Decapoda Cambaridae	u	r				r	r		u
Isopoda Lirceus	u		c	u			u		
Terrestrial isopod		r		u					
Amphipoda Crangonyx			r	c	r	c	a	c	
Diplopoda terrestrial				u	r			r	
Arthropoda – Insecta									
Hemiptera									
Gerridae Gerris									r
Limnoporus		r							
Mesovelidae Mesovelia			u						r
Veliidae Rhagovelia	r	u							
Collembola									
Isotomidae Agrenia								r	r
Odonata									
Aeshnidae Boyeria		r	r						u
Gomphidae									
Stylogomphus		r							
Calopterygidae									
Calopteryx	r	r							r
Ephemeroptera									
Baetidae Baetis	u	c	c	c					a
Centroptilum		c	a	u					a
Caenidae Caenis			c						
Ephemerellidae Drunella			u						c
Ephemerella				r					
Eurylophella	r	u	r	u					a
Ephemeridae Ephemera			r						c
Heptageniidae									
Cinygmula									r
Epeorus									c
Leucrocuta				u					r
Stenonema	c	r	u	u					
Stenacron	u		r						r
Leptophlebiidae									
Habrophlebiodes			u						c
Leptophlebia				r					
Paraleptophlebia	r	c	u						c

Table 4. continued

Taxon	MC8 (4)	MC6 (4)	MC5 (4)	MC3 (3)	GR (4)	CC3 (2)	CC2 (4)	CC1 (4)	RF1 (3)
Ephemeroptera									
Siphlonuridae									
Ameletus			u						r
Tricorythidae									
Tricorythodes			u						
Plecoptera									
Capniidae Allocapnia	r		u	a					
Utacapnia									u
Unidentified				c					
Chloroperlidae									
Haploperla			r						u
Suwallia			u						c
Utaperla		u							c
Leuctridae Leuctra		c	u						
Nemouridae									
Amphinemoura	r								u
Perlidae Acroneuria									u
Agnetina	c	u	u						u
Beloneuria	c	u							u
Perlodidae Diploperla	r	u	u	r					r
Trichoptera									
Glossosomatidae									
Glossosoma			r						
Hydropsychidae									
Cheumatopsyche	c	r	c	u				r	c
Diplectrona	u	r	u	u					a
Hydropsyche	u	u	a	u			c	r	c
Hydroptilidae									
Hydroptila			r					r	
Leptoceridae			r						
Limnephilidae									
Apatania			r						r
Hydatophylax	r								
Philopotamidae									
Chimarra		c	c	r					
Dolophilodes	u	c	c						a
Phryganeidae									
Ptilostomis	r								
Polycentropodidae									
Neureclipsis				u					r
Nyctiophylax	r								
Polycentropus	u	u	u	r					c
Rhyacophilidae									
Rhyacophila	u	r	r						c
Megaloptera									
Corydalidae Nigronia	u	r	r						c
Sialidae Sialis	c								
Coleoptera									
Dytiscidae Agabus	r		r	r					
Hydroporus		c							

Table 4. continued

Taxon	MC8 (4)	MC6 (4)	MC5 (4)	MC3 (3)	GR (4)	CC3 (2)	CC2 (4)	CC1 (4)	RF1 (3)
Elmidae Dubiraphia	u		r						c
Optioservus									u
Oulimnius	c	c	u						c
Stenelmis	c	c	c						c
Psephenidae Psephenus		u	u						a
Diptera									
Ceratopogonidae									
Probezzia	r	r							c
Chironomidae	a	a	a	a	c	a	a	a	a
Dixidae Dixa									r
Dolichopodidae unid.		r				u	u	u	
Empididae Chelifera									r
Clinocera	u	u	u						u
Hemerodromia	u		u			u	c	c	c
Muscidae Limnophora							u		
Simuliidae Simulium	r	u	u	c			c	c	c
Tabanidae Chrysops	u	r	r					u	
Tipulidae Antocha	u	u	u	u				r	r
Dicranota	r	u	u						c
Helius				r					
Hexatoma	u	c	c	u					c
Limonia						u			
Limnophila	r								
Pedicia		r	r	r					
Prionocera	u	r	r						
Pseudolimnophila	u	u	u						
Tipula		u		u	r	u	u	u	a
Unidentified				r			r		
Total number of taxa	45	47	56	32	7	11	18	18	58
No. of taxa "u" or "r"	35	35	44	24	5	8	10	11	26
No. EPT taxa "a" or "c"	4	6	7	3	0	0	1	0	16

Table 5. Benthic macroinvertebrate abundance at sampling sites on third order streams. Criteria for abundance categories defined in text: a = abundant; c = common; u = uncommon; r = rare. Numbers in parentheses indicate number of dates each site was sampled.

Taxon	MC2 (5)	MC1 (4)	RF2 (3)	RF3 (4)
Platyhelminthes				
Planariidae	u	u	c	c
Nematoda	r	r	r	
Annelida				
Oligochaeta fw	c	a	c	a
Lumbricidae	u	u	r	u
Hirudinea type 1	u			
Mollusca				
Ancylidae			u	u
Lymnaeidae				u
Physidae	u		c	u
Bivalvia Pisidium	r			r
Arthropoda - Crustacea				
Decapoda Cambaridae	r		u	r
Isopoda Lirceus	u	c	r	
Terrestrial isopod	r		r	
Amphipoda Crangonyx	u	u		
Diplopoda terrestrial	r	r		r
Arthropoda – Insecta				
Hemiptera				
Gerridae Gerris				r
Trepobates			r	
Mesovelidae Mesovelia			u	
Veliidae Rhagovelia			u	
Odonata				
Aeshnidae Boyeria	r			
Ephemeroptera				
Baetidae Baetis	u	u	r	c
Centroptilum	c	c	u	c
Caenidae Caenis				c
Ephemerellidae Ephemerella				c
Eurylophella	r		r	c
Ephemeridae Ephemera		r		c
Heptageniidae Cinygmula				c
Epeorus			u	c
Leucrocuta				u
Stenonema	u	r	r	c
Stenacron				c
Leptophlebiidae				
Habrophlebiodes			u	u
Paraleptophlebia	u	r	u	a
Oligoneuridae Isonychia				u
Siphlonuridae Ameletus				c
Tricorythidae Tricorythodes			r	
Plecoptera				
Capniidae Allocapnia	c	r		a
Utacapnia	r	r		u

Table 5. continued

Taxon	MC2 (5)	MC1 (4)	RF2 (3)	RF3 (4)
Plecoptera				
Chloroperlidae Sweltsa				c
Utaperla		r	r	u
Leuctridae Leuctra			r	u
Nemouridae Amphinemoura		r	r	r
Perlidae Acroneuria			r	
Agnetina	r		u	r
Beloneuria	u	r	r	
Neoperla				r
Paragnetina				r
Perlodidae Diploperla			r	u
Diura				u
Trichoptera				
Glossosomatidae Glossosoma	r			r
Helicopsychidae Helicopsyche	u			u
Hydropsychidae				
Cheumatopsyche	c	u	u	a
Diplectrona	r	r		r
Hydropsyche	c	u	u	a
Hydroptilidae Hydroptila				u
Limnephilidae Asynarchus			r	
Pseudostenophylax	r			
Philopotamidae Chimarra			c	c
Dolophilodes	u		u	a
Polycentropodidae				
Polycentropus	r	r	r	c
Psychomyiidae Psychomyia				r
Rhyacophilidae Rhyacophila	r		r	c
Uenoidae Neophylax				r
Megaloptera				
Corydalidae Nigronia	r	r	r	u
Sialidae Sialis			r	
Coleoptera				
Dytiscidae Hydroporus	r			u
Unidentified			r	
Elmidae Dubiraphia				r
Optioservus				u
Oulimnius		r	c	c
Stenelmis	u	c	u	c
Psephenidae Psephenus	u	r	c	a
Diptera				
Ceratopogonidae Probezzia	r	r		
Chironomidae	a	a	a	a
Dolichopodidae unid.	r			
Empididae Clinocera	r			u
Hemerodromia	r		u	c
Ephydridae unid.		r		
Muscidae unidentified	r	r		
Simuliidae Simulium	c	c	c	u
Tabanidae Unidentified	r			

Table 5. continued

Taxon	MC2 (5)	MC1 (4)	RF2 (3)	RF3 (4)
Diptera				
Tipulidae Antocha	u	r	r	u
Dicranota			c	c
Hexatoma	u	r	r	c
Limnophila	r	u	r	u
Molophilus		r		
Pedicia		r		
Prionocera	c	u		
Pseudolimnophila				r
Tipula	u	u	c	c
Total number of taxa	48	37	48	65
Number of taxa "u" or "r"	40	31	38	34
Number of EPT taxa "a" or "c"	4	1	1	21

Table 6. Composite Index Scores for first order stream sites and summary classification.

Site	Scores per date	Average	Summary classification
Mill Creek Sites			
MC4	37, 30, 25, 20	28	slightly degraded
MC7	22, 20, 23	21.6	slightly degraded
MCR1	15	15	poor
MCR2	47	47	good
MCR3	40	40	good
Cascade Creek Sites			
CC4	11, 11, 13, 14	12	very poor
CC5	7, 6	6.5	very poor
CC6	11, 12, 13, 14	12.5	very poor
Scott Run			
SR	14, 9, 16, 18	14.25	poor
Reference Sites			
MSS	8	8	very poor
16MR1	52	52	very good
ElkR1	29	29	fair
ElkR2	54	54	very good
ElkR3	53, 35	44	good
ElkR4	35, 28	31.5	fair
12MR1	42	42	good
ElkR5	40	40	good
ElkR6	51	51	very good

Table 7. Composite Index Scores for second order stream sites and summary classification.

Site	Scores per date	Average	Summary classification
Mill Creek Sites			
MC3	39, 17, 14	23.3	poor
MC5	41, 25, 45, 43	38.5	fair
MC6	19, 14, 29, 35	24.2	poor
MC8	29, 24, 26, 36	28.7	slightly degraded
Garrison Run			
GR	6, 6, 6, 6	6	minimal biological diversity
Cascade Creek Sites			
CC1	10, 12, 13, 10	11.2	very poor
CC2	11, 11, 12, 10	11	very poor
CC3	11, 9	10	very poor
Reference Sites			
McDR	10, 12, 11	11	very poor
RF1	44, 34, 51	43	fair
16MR2	50	50	good
12MR2	52	52	good/very good
4MR1	43	43	fair
WalnR1	44	44	fair/good
WalnR2	59	59	very good
ElkR7	53	53	very good
ElkR8	52	52	good/very good
ElkR9	51	51	good
ElkR10	58	58	very good

Table 8. Composite Index Scores for third order stream sites and summary classification.

Site	Scores per date	Average	Summary classification
Mill Creek Sites			
MC1	24, 21, 25, 19	22	poor
MC2	26, 30, 20, 32	28	slightly degraded
Reference Sites			
MCR4	16	16	poor
RF2	26, 37, 25	29	slightly degraded
RF3	38, 45, 50, 51	46	good
16MR3	21	21	poor
16MR4	50	50	good
16MR5	60	60	optimum condition
20MR1	45	45	fair/good
ElkR11	48	48	good
ElkR12	60	60	optimum condition
WalnR3	43	43	fair

Appendix A.

Supplemental reference site designations, stream order, location/descriptions, and dates sampled.

Site	Stream Order	Location	Dates sampled
		Presque Isle Bay Watershed Sites	
Mill Creek			
MCR1	1	W. 41st St.	7-19-01
MCR2*	1	E. of Rt. 97 - A	9-16-01
MCR3*	1	E. of Rt. 97 – B	9-16-01
MCR4	3	Below zoo N. of 38th St.	10-16-01
Myrtle Street Sewer			
MSS	1	E. of Chestnut St. water plant	10-12-01
		Sites Outside Presque Isle Bay Watershed	
McDannel's Run			
McDR	2	S. of Rte 5 near GE	5-11-01, 8-1-01, 10-3-01
Fourmile Creek			
4MR1*	2	S. of I-90	11-29-01
Twelvemile Creek			
12MR1*	1	W. Branch, S. of Rt. 20	11-27-01
12MR2*	2	E. Branch, N. of I-90	12-20-01
Sixteenmile Creek			
16MR1*	1	S. of I-90 near Rt. 89	12-20-01
16MR2*	2	S. of I-90 near Rt. 89	12-20-01
16MR3	3	S. of Rt. 5 below North East	11-27-01
16MR4*	3	S. of North East	11-27-01
16MR5*	3	E. Branch near Oxbow Rd.	12-20-01
Twentymile Creek			
20MR1*	3-4	N. of I-90	11-27-01
Walnut Creek			
WalnR1*	2	Rt. 97 @ French Quarters	12-3-01
WalnR2*	2	Thomas Run on Thomas Road	12-3-01
WalnR3*	3	N. of Sterrettania Rd.	12-3-01
Elk Creek			
ElkR1*	1	Kubiak's property on New Rd.	6-6-01
ElkR2*	1	Stancliff Rd. W. of Eureka	5-23-01
ElkR3*	1	VanCamp Rd. W. of Elk Valley Golf	5-23-01, 10-25-01
ElkR4*	1	Stancliff Rd. W. of I-79	5-23-01, 10-25-01
ElkR5*	1	N. of I-90 near Girard	6-8-01
ElkR6*	1	Ravine NE of Reed's Corners	6-6-01
ElkR7*	2	Hamot Rd.	12-3-01
ElkR8*	2	W. of Rt. 98	12-10-01
ElkR9*	2	Hall's Run	12-10-01
ElkR10*	2	W. of Franklin Center	12-10-01
ElkR11*	3	E. of I-79	12-3-01
ElkR12*	3	W. of Franklin Center	12-10-01

*In addition to RF1 and RF3, sites in less developed areas relatively unimpacted by NPSP that were used during the final step of the multimetric data analysis, to objectively determine categories of biological condition (e.g. "good," "fair," "poor," etc.).

Appendix B. Sample metrics for first order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff
BelValF1	18	4	6	10	31	7.12
BelValSu	19	5	6	3	24	6.96
BelValF2	17	2	6	8	36	6.46
OldFrnF1	13	6	10	41	67	4.56
OldFrnSp	23	9	10	19	12	5.49
OldFrnSu	19	5	10	11	24	5.92
OldFrnF2	10	1	2	4	49	5.77
Cas16F1	12	0	1	0	2	7.7
Cas16Sp	8	0	1	0	0.1	6.17
Cas16Su	14	1	3	0.4	2	7.34
Cas16F2	12	1	4	0.3	8	7.24
WErPlzSu	5	0	0	0	0	8.93
WErPlzF2	3	0	0	0	0	9.58
HrdngF1	9	0	1	0	4	6.9
HrdngSp	9	0	0	0	0	7.14
HrdngSu	10	1	3	3	10	7.53
HrdngF2	11	1	3	2	6	7.91
ScottF1	8	1	2	1	27	6.67
ScottSp	6	0	1	0	1	7.37
ScottSu	9	1	3	2	19	5.9
ScottF2	9	0	2	0	52	5.98
MlkW41	12	1	2	16	18	7.34
MlkEgr1	17	9	11	74	78	3.55
MlkEgr2	12	6	6	60	83	2.45
MrtStSewr	6	0	1	0	13	9.02
16Mile	29	10	18	55	65	4.24
ElkKub	21	9	11	15	12	6.22
ElkStnclf	36	17	22	49	58	4.22
ElkVnCmp	42	22	29	59	47	4.16
ElkVnCmp	17	8	11	40	21	3.78
Elkl79	22	9	12	12	17	6.96
Elkl79	13	4	7	90	91	0.77
12Mile	16	3	8	65	67	4.76
ElkUncJo	23	15	16	30	32	6.72
ElkReeds	28	13	17	60	55	3.59
95%ile	31.1	15.6	19.2	67.7	79.5	8.957
5%ile						3.22

Appendix C. Sample metrics for second order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff
BelValMF	13	5	9	15	21	8.51
BelValMS	15	6	10	3	2	9.78
BelValMS	29	11	18	9	12	7.88
BelValMF	28	11	17	24	40	7.15
EGoreF1	25	13	14	44	72	5.91
EGorSp	18	9	11	17	10	7
EGorSum	38	16	19	46	46	6.45
EGorF2	30	14	15	57	57	5.19
GarRunF1	3	0	1	0	2	9.82
GarRunSp	3	0	0	0	0	10
GarRunSu	3	0	0	0	0	9.57
GarRunF2	3	0	0	0	0	9.99
CasGreSu	7	0	2	0	4	6.81
CasGreF2	10	0	1	0	0.4	8.73
CasFrnF1	6	1	2	1	2	6.96
CasFrnSp	8	0	1	0	0.5	6.63
CasFrnSu	12	0	2	0	1	6.91
CasFrnF2	14	1	2	0.8	1.4	8.81
CasMthF1	10	0	3	0	4	8.31
CasMthSp	7	0	0	0	0	6.19
CasMthSu	13	2	2	1	1	6.86
CasMthF2	9	1	2	0.6	1	8.06
GlnvRF1	20	10	12	50	50	4.05
GlnvRSu	15	5	5	8	4	7.21
GlnvRF2	15	5	8	7	8	8.96
McDnRSp	6	0	2	0	4	7.49
McDnRSu	7	0	1	0	3	6.43
McDnRF2	8	0	1	0	3	6.94
7MileUSp	42	25	27	29	21	5.71
7MileUSu	33	12	19	11	21	6.45
7MileUF2	33	15	17	59	74	3.78
16MileF2	24	12	16	74	77	2.21
12MileEF	24	16	18	93	94	1.78
4MileF2	34	19	22	31	36	6.38
WlnU1F2	35	16	20	51	41	5.99
WlnTmF2	39	19	26	74	79	3.28
ElkHamF2	43	25	32	54	54	4.64
Elk98F2	34	14	18	61	81	3.44
ElkHallF2	32	16	19	58	66	4.42
ElkFrCF2	32	21	23	89	91	3.08
HwprkF1	15	8	8	37	57	6.2
HwprkSp	17	6	9	15	22	5.78
HwprkSu	22	8	11	11	16	5.78
HwprkF2	31	12	16	28	31	5.62
95%ile	38.85	20.7	25.55	74	80.7	9.814
5%ile						3.11

Appendix D. Sample metrics for third order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff
AbvzooF1	16	4	8	22	53	5.81
AbvzooF1	21	7	9	38	44	5.95
AbzooSp	13	6	7	17	21	7.5
AbvzooSu	28	10	16	21	21	5.5
AbvzooF2	18	9	12	55	39	5.8
34thStF1	17	6	8	19	27	6.31
34thStSp	14	6	7	23	20	6.64
34thStSu	26	8	13	7	9	6.17
34thStF2	15	4	6	11	11	6.39
BelzooF2	9	3	9	19	9	8.67
7mileLSp	20	12	13	11	10	6.19
7mileLSu	32	12	18	25	45	5.85
7mileLF2	19	5	10	14	52	6.47
12mileLSp	28	18	22	23	24	4.94
12mileLSu	33	16	22	42	53	5.05
12mileLF2	32	20	21	59	66	4.48
12mileLF2	37	17	23	56	68	4.41
16mileLF2	26	7	12	10	13	8.83
16mileUF2	33	23	26	56	57	5.1
16mileUE	38	23	27	83	89	1.62
20mileF2	27	14	18	71	64	5
ElkF2	33	16	21	66	55	4.84
ElkFrF2	39	24	29	86	87	2.68
WalnF2	30	13	21	69	38	5.75
95%ile	37.85	23	26.85	81.2	84.15	8.4945
5%ile						2.9395

Appendix E. Standardized metric and composite index scores for first order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff	Composite
BelValF1	6	3	3	2	4	4	22
BelValSu	6	3	3	1	3	4	20
BelValF2	6	2	3	2	5	5	23
OldFrnF1	5	4	5	6	9	8	37
OldFrnSp	8	6	5	3	2	6	30
OldFrnSu	6	3	5	2	3	6	25
OldFrnF2	4	1	1	1	7	6	20
Cas16F1	4	1	1	1	1	3	11
Cas16Sp	3	1	1	1	1	5	12
Cas16Su	5	1	2	1	1	3	13
Cas16F2	4	1	3	1	1	4	14
WErPlzSu	2	1	1	1	1	1	7
WErPlzF2	1	1	1	1	1	1	6
HrdngF1	3	1	1	1	1	4	11
HrdngSp	3	1	1	1	1	4	11
HrdngSu	4	1	2	1	2	3	13
HrdngF2	4	1	2	1	1	3	14
ScottF1	3	1	1	1	4	4	14
ScottSp	2	1	1	1	1	3	9
ScottSu	3	1	2	1	3	6	16
ScottF2	3	1	1	1	7	5	18
MlkW41	4	1	1	3	3	3	15
MlkEgr1	6	6	6	10	10	9	47
MlkEgr2	4	4	3	9	10	10	40
MrtStSewr	2	1	1	1	2	1	8
16Mile	10	6	10	9	9	8	52
ElkKub	7	6	6	3	2	5	29
ElkStnclf	10	10	10	8	8	8	54
ElkVnCmp	10	10	10	9	6	8	53
ElkVnCmp	6	5	6	6	3	9	35
Elkl79	7	6	6	2	3	4	28
Elkl79	5	3	4	10	10	10	42
12Mile	5	2	4	10	9	7	37
ElkUncJo	8	10	9	5	4	4	40
ElkReeds	9	8	9	9	7	9	51

Appendix F. Standardized metric and composite index scores for 2nd order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff	Composite
BelValMF	4	3	4	2	3	3	19
BelValMS	4	3	4	1	1	1	14
BelValMS	8	6	7	2	2	4	29
BelValMF	8	6	7	4	5	5	35
EGoreF1	7	7	6	6	9	6	41
EGorSp	5	5	5	3	2	5	25
EGorSum	10	8	8	7	6	6	45
EGorF2	8	7	6	8	7	7	43
GarRunF1	1	1	1	1	1	1	6
GarRunSp	1	1	1	1	1	1	6
GarRunSu	1	1	1	1	1	1	6
GarRunF2	1	1	1	1	1	1	6
CasGreSu	2	1	1	1	1	5	11
CasGreF2	3	1	1	1	1	2	9
CasFrnF1	2	1	1	1	1	5	11
CasFrnSp	2	1	1	1	1	5	11
CasFrnSu	3	1	1	1	1	5	12
CasFrnF2	4	1	1	1	1	2	10
CasMthF1	3	1	1	1	1	3	10
CasMthSp	2	1	1	1	1	6	12
CasMthSu	4	1	1	1	1	5	13
CasMthF2	3	1	1	1	1	3	10
GlnvRF1	6	5	5	7	7	9	39
GlnvRSu	4	3	2	2	1	5	17
GlnvRF2	4	3	3	1	1	2	14
McDnRSp	2	1	1	1	1	4	10
McDnRSu	2	1	1	1	1	6	12
McDnRF2	2	1	1	1	1	5	11
7MileUSp	10	10	10	4	3	7	44
7MileUSu	9	6	8	2	3	6	34
7MileUF2	9	7	7	8	10	10	51
16MileF2	7	6	7	10	10	10	50
12MileEF	7	8	7	10	10	10	52
4MileF2	9	9	9	5	5	6	43
WlnU1F2	9	8	8	7	6	6	44
WlnTmF2	10	9	10	10	10	10	59
ElkHamF2	10	10	10	8	7	8	53
Elk98F2	9	7	7	9	10	10	52
ElkHallF2	9	8	8	8	9	9	51
ElkFrCF2	9	10	9	10	10	10	58
HwprkF1	4	4	3	5	7	6	29
HwprkSp	5	3	4	2	3	7	24
HwprkSu	6	4	5	2	2	7	26
HwprkF2	8	6	7	4	4	7	36

Appendix G. Standardized metric and composite index scores for 3rd order stream reaches

Site/date	Total Taxa	EPT Taxa	Intol. Taxa	%EPT	%Intol.	Hilsenhoff	Composite
AbvzooF1	5	2	3	3	7	6	26
AbvzooF1	6	3	4	5	6	6	30
AbzooSp	4	3	3	3	3	4	20
AbvzooSu	8	5	6	3	3	7	32
AbvzooF2	5	4	5	7	5	6	32
34thStF1	5	3	3	3	4	6	24
34thStSp	4	3	3	3	3	5	21
34thStSu	7	4	5	1	2	6	25
34thStF2	4	2	3	2	2	6	19
BelzooF2	3	2	4	3	2	2	16
7mileLSp	6	5	5	2	2	6	26
7mileLSu	9	5	7	4	6	6	37
7mileLF2	5	2	4	2	7	5	25
12mileLSp	8	8	8	3	3	8	38
12mileLSu	9	7	8	6	7	8	45
12mileLF2	9	9	8	8	8	8	50
12mileLF2	10	8	9	7	9	8	51
16mileLF2	7	3	5	2	2	2	21
16mileUF2	9	10	10	7	7	7	50
16mileUE	10	10	10	10	10	10	60
20mileF2	7	6	7	9	8	8	45
ElkF2	9	7	8	9	7	8	48
ElkFrF2	10	10	10	10	10	10	60
WalnF2	8	6	8	9	5	7	43