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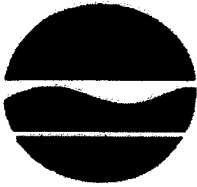
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# Butternut Creek

## Biological Assessment



2003 Survey

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# BUTTERNUT CREEK

## BIOLOGICAL ASSESSMENT

Susquehanna River Basin  
Otsego County, New York

Survey date: July 3 and 7, 2003

Report date: March 3, 2004

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Stream: Butternut Creek, Otsego County, New York

Reach: Garrattsville to Mt. Upton, New York

NYS Drainage Basin: Susquehanna River

Background:

The Stream Biomonitoring Unit conducted biological sampling on Butternut Creek on July 7, 2003. The purpose of the sampling was to assess general water quality, and determine any spatial or chronological water quality trends. Traveling kick samples for macroinvertebrates were taken in riffle areas at 8 sites, using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT value, and PMA (see Appendices II and III). Table 2 provides a listing of sampling sites, and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by macroinvertebrate data reports, including individual site descriptions and raw invertebrate data from each site.

Results and Conclusions:

1. Based on macroinvertebrate sampling, water quality in Butternut Creek ranged from non-impacted to slightly impacted. Siltation and nutrient enrichment were the only impacts noted. Water quality is not considered to be limiting to populations of fish or other stream life.

## Discussion

Butternut Creek arises from the slopes of Angel Hill near Exeter Corner in Otsego County, and flows approximately 37 miles in a southwesterly direction before joining the Unadilla River near Mt. Upton. The watershed is primarily agricultural. Most of the stream is classified as C (T), with portions of C, B(T), and C(TS). It is stocked annually with brown trout. The sites sampled in the present survey were 8-25 meters wide, and had current speeds of 100-125 cm/sec in riffles.

Butternut Creek was sampled once previously by the Stream Biomonitoring Unit, at the Mt Upton site in 1997. Based on field inspection of the macroinvertebrate community, water quality was assessed as non-impacted, and the sample was not processed. The present survey was conducted to provide data towards understanding the apparent decline in hellbender populations at the Mt Upton site (Pers. comm., Alvin Breisch, NYS DEC Fish & Wildlife). Creosoted bridge supports at the Mt Upton site was considered a possible cause of the decline.

Based on macroinvertebrate sampling from Garrattsville to Mt Upton, water quality in Butternut Creek ranged from non-impacted to slightly impacted (Figure 1). Only one site, in Morris, was assessed as slightly impacted. Impact Source Determination (Table 1) did not clearly distinguish the cause of impact at this site, although siltation and nutrient enrichment may be involved. Water quality recovered to upstream conditions 2 miles downstream, at Station 4. At all other sites, Butternut Creek water quality was assessed as non-impacted, and is not considered limiting to populations of fish or other stream life. There was no evidence of toxicity at the Mt Upton site downstream of the bridge.

Aquatic worms were numerous at the Mt Upton sites (Stations 7-8), constituting 30% of the sample upstream of the bridge, and 14% downstream of the bridge. Most aquatic worms feed on bacteria, and an increase in their numbers often signals an increase in decomposable wastes that support the bacteria. These worms are Lumbriculidae; they have been demonstrated to tolerate light degrees of pollution (Lang and Lang-Dobler, 1979), but are most often found at non-impacted sites. Whether the source of wastes is human or livestock, the diverse macroinvertebrate communities at these sites indicate that the stream has adequate assimilative capacity to maintain non-impacted water quality. No indication was found at these sites that would indicate limitations to hellbender populations.

## Literature Cited:

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and A. J. Smith. 2002. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Technical Report, 115 pages.

## Overview of field data

On the dates of sampling, July 3 and 7, 2003, Butternut Creek at the sites sampled was 8-25 meters wide, 0.2-0.3 meters deep, and had current speeds of 100-125 cm/sec in riffles. Dissolved oxygen was 7.8-10.2 mg/l, specific conductance was 147-170  $\mu$ mhos, pH was 6.0-7.4 and the temperature was 18.1-23.2 °C (65-74 °F). Measurements for each site are found on the field data summary sheets.

TABLE 2. STATION LOCATIONS FOR BUTTERNUT CREEK,  
OTSEGO COUNTY, NEW YORK (see map).

<u>STATION</u>	<u>LOCATION</u>
1	Garrattsville 40 m above Co. Rte. 16 bridge 25.5 miles above the mouth Latitude/longitude: 42°38'41" 75°10'13"
2	New Lisbon 20 m above Co. Rte. 12 bridge 20.6 miles above the mouth Latitude/longitude: 42°35'22" 75°11'35"
3	Morris 50 m above Rte. 23 bridge 16.0 miles above the mouth Latitude/longitude: 42°32'44" 75°14'18"
4	Below Morris 20 m above Peet Rd. bridge 14.0 miles above the mouth Latitude/longitude: 42°31'27" 75°15'20"
5	Gilbertsville 20 m below Spring St. bridge 6.3 miles above the mouth Latitude/longitude: 42°27'52" 75°19'18"
6	Copes Corner 50 m above Co. Rte. 13 bridge 2.8 miles above the mouth Latitude/longitude: 42°26'14" 75°20'44"
7	Mt. Upton 200 m above Flatiron Rd. bridge 1.5 miles above the mouth Latitude/longitude: 42°25'24" 75°21'28"
8	Mt. Upton 150 m below Flatiron Rd. bridge 1.3 miles above the mouth Latitude/longitude: 42°25'10" 75°21'41"



**TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN BUTTERNUT CREEK,  
OTSEGO COUNTY, NEW YORK, 2003.**

PLATYHELMINTHES

TURBELLARIA

Undetermined Turbellaria

OLIGOCHAETA

LUMBRICULIDA

Lumbriculidae

Undetermined Lumbriculidae

TUBIFICIDA

Enchytraeidae

Undetermined Enchytraeidae

MOLLUSCA

PELECYPODA

Sphaeriidae

Pisidium sp.

Sphaerium sp.

Undetermined Sphaeriidae

ARTHROPODA

INSECTA

EPHEMEROPTERA

Isonychiidae

Isonychia bicolor

Baetidae

Acentrella sp.

Baetis flavistriga

Baetis intercalaris

Centroptilum sp.

Heptageniidae

Epeorus (Iron) sp.

Heptagenia sp.

Leucrocuta sp.

Rhithrogena sp.

Stenonema ithaca

Stenonema terminatum

Leptophlebiidae

Paraleptophlebia mollis

Ephemerellidae

Drunella cornuta

Serratella deficiens

Serratella sp.

Ephemeridae

Ephemera sp.

PLECOPTERA

Leuctridae

Leuctra sp.

Perlidae

Agnetina capitata

Neoperla sp.

Paragnetina immarginata

Paragnetina media

COLEOPTERA

Psephenidae

Psephenus herricki

Elmidae

Dubiraphia vittata

Optioservus fastiditus

Optioservus ovalis

Optioservus trivittatus

Promoresia elegans

Stenelmis crenata

TRICHOPTERA

Philopotamidae

Chimarra aterrima?

Chimarra obscura

Dolophilodes sp.

Polycentropodidae

Polycentropus sp.

Hydropsychidae

Cheumatopsyche sp.

Hydropsyche bronta

Hydropsyche morosa

Hydropsyche slossonae

Hydropsyche sparna

Hydropsyche sp.

Rhyacophilidae

Rhyacophila fuscula

Glossosomatidae

Glossosoma sp.

Brachycentridae

Brachycentrus appalachia

Leptoceridae

Oecetis avara

DIPTERA

Tipulidae

Dicranota sp.

Hexatoma sp.

Ceratopogonidae

Undetermined Ceratopogonidae

Simuliidae

Simulium sp.

Athericidae

Atherix sp.

Chironomidae

Tanypodinae

Thienemannimyia gr. spp.

Diamesinae

Diamesa sp.

Pagastia orthogonia

**TABLE 3, cont. MACROINVERTEBRATE SPECIES COLLECTED IN BUTTERNUT CREEK,  
OTSEGO COUNTY, NEW YORK, 2003.**

DIPTERA (cont'd)

Chironomidae

Orthoclaadiinae

*Cardiocladius albiplumus*  
*Cardiocladius obscurus*  
*Cricotopus bicinctus*  
*Cricotopus tremulus* gr.  
*Cricotopus trifascia* gr.  
*Cricotopus vierriensis*  
*Eukiefferiella devonica* gr.  
*Orthocladus* nr. *dentifer*  
*Parametriocnemus lundbecki*  
*Tvetenia vitracies*

Chironominae

Chironomini

*Microtendipes pedellus* gr.  
*Polypedilum aviceps*  
*Polypedilum flavum*  
*Polypedilum illinoense*

Tanytarsini

*Rheotanytarsus exiguus* gr.  
*Rheotanytarsus pellucidus*  
*Sublettea coffmani*  
*Tanytarsus glabrescens* gr.  
*Tanytarsus guerlus* gr.

STREAM SITE: Butternut Creek, Station 01  
 LOCATION: Garrattsville, New York, 40 meters above County Route 16  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

MOLLUSCA

PELECYPODA

Sphaeriidae Undetermined Sphaeriidae 3

ARTHROPODA

INSECTA

EPHEMEROPTERA

Isonychiidae Isonychia bicolor 2  
 Baetidae Acentrella sp. 4  
 Baetis intercalaris 4  
 Heptageniidae Heptagenia sp. 6  
 Stenonema ithaca 1  
 Leptophlebiidae Paraleptophlebia mollis 17  
 Ephemerellidae Drunella cornuta 2  
 Serratella deficiens 4  
 Ephemeridae Ephemera sp. 1

PLECOPTERA

Leuctridae Leuctra sp. 1  
 Perlidae Agnetina capitata 2

COLEOPTERA

Psephenidae Psephenus herricki 4  
 Elmidae Dubiraphia vittata 1  
 Optioservus ovalis 9  
 Promoresia elegans 1  
 Stenelmis crenata 2

TRICHOPTERA

Philopotamidae Dolophilodes sp. 3  
 Polycentropodidae Polycentropus sp. 1  
 Hydropsychidae Cheumatopsyche sp. 1  
 Hydropsyche sparna 11

DIPTERA

Tipulidae Dicranota sp. 1  
 Athericidae Atherix sp. 3  
 Chironomidae Thienemannimyia gr. spp. 1  
 Pagastia orthogonia 2  
 Cardiocladius obscurus 2  
 Eukiefferiella devonica gr. 1  
 Parametriocnemus lundbecki 4  
 Polypedilum aviceps 3  
 Polypedilum flavum 2  
 Rheotanytarsus pellucidus 1

SPECIES RICHNESS: 31 (very good)  
 BIOTIC INDEX: 3.48 (very good)  
 EPT RICHNESS: 15 (very good)  
 MODEL AFFINITY: 86 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: This site featured excellent habitat. An excellent macroinvertebrate community was present. While a cornfield was adjacent to the stream, and the stream showed some indication of siltation and algal growth, all macroinvertebrate metrics were within the range of non-impacted water quality.

STREAM SITE: Butternut Creek, Station 02  
 LOCATION: New Lisbon, New York, 20 meters above County Route 12 bridge  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	1
TUBIFICIDA	Enchytraeidae	Undetermined Enchytraeidae	1

ARTHROPODA

INSECTA

EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	3	
	Baetidae	Acentrella sp.	21	
		Baetis intercalaris	10	
		Centroptilum sp.	1	
		Heptageniidae	Heptagenia sp.	14
		Stenonema ithaca	1	
	Leptophlebiidae	Paraleptophlebia mollis	10	
	Ephemerellidae	Drunella cornuta	5	
		Serratella deficiens	6	
		Leuctridae	Leuctra sp.	1
	PLECOPTERA	Psephenidae	Psephenus herricki	1
		Elmidae	Optioservus ovalis	2
			Optioservus trivittatus	4
	TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	2
DIPTERA	Tipulidae	Antocha sp.	1	
		Hexatoma sp.	1	
		Ceratopogonidae	Undetermined Ceratopogonidae	1
	Athericidae	Atherix sp.	1	
	Chironomidae	Cricotopus bicinctus	1	
		Cricotopus trifascia gr.	1	
		Cricotopus vierriensis	1	
		Parametrioctenemus lundbecki	1	
		Tvetenia vitracies	1	
		Polypedilum aviceps	5	
		Polypedilum flavum	1	
	Polypedilum illinoense	1		
	Rheotanytarsus exiguus gr.	1		

SPECIES RICHNESS: 29 (very good)  
 BIOTIC INDEX: 3.58 (very good)  
 EPT RICHNESS: 11 (very good)  
 MODEL AFFINITY: 69 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: Habitat was acceptable at this site, although the stream had no canopy. Some siltation and algal growth was evident. All macroinvertebrate metrics were within the range of non-impacted water quality.



STREAM SITE: Butternut Creek, Station 03  
 LOCATION: Morris, New York, 50 meters above Route 23  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	2
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ARTHROPODA

INSECTA

EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	3
	Baetidae	Acentrella sp.	16
		Baetis intercalaris	3
		Heptageniidae	Heptagenia sp.
	Leptophlebiidae	Paraleptophlebia mollis	19
	Ephemerellidae	Drunella cornuta	3
COLEOPTERA	Elmidae	Optioservus trivittatus	3
		Stenelmis crenata	1
TRICHOPTERA	Philopotamidae	Dolophilodes sp.	1
	Hydropsychidae	Hydropsyche bronta	3
DIPTERA	Simuliidae	Simulium sp.	1
		Chironomidae	Diamesa sp.
		Cardiocladius obscurus	3
		Cricotopus tremulus gr.	1
		Cricotopus vierriensis	3
		Parametriocnemus lundbecki	1
	Polypedilum aviceps	35	

SPECIES RICHNESS: 18 (poor)  
 BIOTIC INDEX: 3.51 (very good)  
 EPT RICHNESS: 8 (good)  
 MODEL AFFINITY: 71 (very good)  
 ASSESSMENT: slightly impacted

DESCRIPTION: The sample was taken upstream of the Route 23 bridge in the village of Morris. The macroinvertebrate fauna included mayflies, stoneflies, and caddisflies, but species richness was low, resulting in an assessment of slight impact. Many worms were noted in the field. Impact Source Determination did not clearly identify the source of impact, although the community was similar (38%) to communities affected by siltation and nutrient enrichment.

STREAM SITE: Butternut Creek, Station 04  
 LOCATION: Below Morris, New York, 20 meters above Peet Road bridge  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ANNELIDA

OLIGOCHAETA

LUMBRICULIDA

Lumbriculidae	Undetermined Lumbriculidae	4
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ARTHROPODA

INSECTA

EPHEMEROPTERA

Isonychiidae	Isonychia bicolor	3	
Baetidae	Acentrella sp.	11	
	Baetis flavistriga	2	
	Baetis intercalaris	10	
	Heptageniidae	Epeorus (Iron) sp.	1
		Rhithrogena sp.	1
Leptophlebiidae	Paraleptophlebia mollis	14	
Ephemerellidae	Drunella cornuta	1	
	Serratella deficiens	15	

COLEOPTERA

TRICHOPTERA

Elmidae	Optioservus trivittatus	8	
Philopotamidae	Dolophilodes sp.	2	
	Hydropsychidae	Hydropsyche bronta	2
	Hydropsyche slossonae	1	
	Hydropsyche sparna	7	
Glossosomatidae	Glossosoma sp.	2	
Brachycentridae	Brachycentrus appalachia	6	
DIPTERA	Tipulidae	Hexatoma sp.	2
	Chironomidae	Orthocladius nr. dentifer	1
			Tvetenia vitracies
	Polypedilum aviceps	5	

SPECIES RICHNESS: 21 (good)  
 BIOTIC INDEX: 3.02 (very good)  
 EPT RICHNESS: 15 (very good)  
 MODEL AFFINITY: 72 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: The kick sample was taken in a linear riffle downstream of a flat reach of stream. The macroinvertebrate fauna was dominated by clean-water mayflies, and most of the metrics indicated non-impacted conditions.

STREAM SITE: Butternut Creek, Station 05  
 LOCATION: Gilbertsville, New York, 20 meters downstream of Spring Street  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ARTHROPODA

INSECTA

EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	4
		Baetidae	Acentrella sp.
	Heptageniidae	Baetis intercalaris	2
		Epeorus (Iron) sp.	1
		Heptagenia sp.	2
	Leptophlebiidae	Paraleptophlebia mollis	1
	Ephemerellidae	Drunella cornuta	7
		Serratella deficiens	14
		Serratella sp.	1
	PLECOPTERA	Perlidae	Agneta capitata
Paragnetina immarginata			1
COLEOPTERA	Perlodidae	Undetermined Perlodidae	1
	Psephenidae	Psephenus herricki	1
TRICHOPTERA	Elmidae	Dubiraphia vittata	1
		Optioservus fastiditus	1
		Optioservus trivittatus	3
		Promoresia elegans	6
		Stenelmis crenata	9
	Philopotamidae	Chimarra aterrima?	2
		Chimarra obscura	3
	Hydropsychidae	Dolophilodes sp.	1
		Hydropsyche bronta	12
		Hydropsyche sparna	10
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia orthogonia	2
		Eukiefferiella devonica gr.	2
		Tvetenia vitracies	2
		Polypedilum aviceps	1

SPECIES RICHNESS: 28 (very good)  
 BIOTIC INDEX: 3.55 (very good)  
 EPT RICHNESS: 17 (very good)  
 MODEL AFFINITY: 71 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: This site was downstream of several miles of wetland areas. The water appeared more turbid, and more filter-feeding caddisflies were present. Nevertheless, all macroinvertebrate metrics were within the range of non-impacted water quality.

STREAM SITE: Butternut Creek, Station 06  
 LOCATION: Copes Corners, New York, 50 meters above County Route 13 bridge  
 DATE: 07 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	6
MOLLUSCA			
PELECYPODA			
	Sphaeriidae	Pisidium sp.	1
		Sphaerium sp.	2
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	5
	Baetidae	Acentrella sp.	11
	Heptageniidae	Heptagenia sp.	6
	Leptophlebiidae	Paraleptophlebia mollis	3
	EphemereIIDae	Drunella cornuta	5
		Serratella deficiens	1
PLECOPTERA	Perlidae	Agnetina capitata	1
		Neoperla sp.	1
		Paragnetina media	1
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Optioservus trivittatus	4
		Stenelmis crenata	19
TRICHOPTERA	Philopotamidae	Chimarra obscura	2
	Polycentropodidae	Polycentropus sp.	1
	Hydropsychidae	Cheumatopsyche sp.	2
		Hydropsyche morosa	11
		Hydropsyche sparna	2
	Rhyacophilidae	Rhyacophila fuscula	2
	Glossosomatidae	Glossosoma sp.	1
DIPTERA	Athericidae	Atherix sp.	1
	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia orthogonia	1
		Cardiocladius obscurus	2
		Cricotopus vierriensis	1
		Tvetenia vitracies	1
		Polypedilum aviceps	2
		Polypedilum illinoense	1
		Tanytarsus glabrescens gr.	1
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS: 32 (very good)  
 BIOTIC INDEX: 4.17 (very good)  
 EPT RICHNESS: 16 (very good)  
 MODEL AFFINITY: 74 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: The sample was taken upstream of the County Route 13 bridge at Copes Corners. The habitat was judged to be adequate. Although the macroinvertebrate fauna appeared to have a lower biomass than at the upstream site, all metrics indicated non-impacted water quality.

STREAM SITE: Butternut Creek, Station 07  
 LOCATION: Mt. Upton, New York, 200 meters upstream of Flatiron Road bridge  
 DATE: 03 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	30
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Acentrella sp.	4
		Baetis flavistriga	4
		Baetis intercalaris	6
	Heptageniidae	Heptagenia sp.	1
		Rhithrogena sp.	4
		Stenonema terminatum	1
	Leptophlebiidae	Paraleptophlebia mollis	1
	Ephemerellidae	Drunella cornuta	2
		Serratella sp.	3
PLECOPTERA	Perlidae	Agnatina capitata	6
COLEOPTERA	Psephenidae	Psephenus herricki	3
	Elmidae	Optioservus trivittatus	4
		Stenelmis crenata	10
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	1
	Hydropsychidae	Cheumatopsyche sp.	1
		Hydropsyche bronta	8
		Hydropsyche sparna	1
DIPTERA	Chironomidae	Cardiocladius obscurus	2
		Cricotopus trifascia gr.	2
		Cricotopus vierriensis	2
		Orthocladius nr. dentifer	1
		Tvetenia vitracies	1
		Microtendipes pedellus gr.	1
		Sublettea coffmani	1

SPECIES RICHNESS: 25 (good)  
 BIOTIC INDEX: 4.37 (very good)  
 EPT RICHNESS: 14 (very good)  
 MODEL AFFINITY: 66 (very good)  
 ASSESSMENT: non-impacted.

DESCRIPTION: The sample was taken 200 meters upstream of the Flatiron Road bridge. Aquatic worms were numerous in the sample, constituting 30% of the macroinvertebrate fauna. However, they were not a tolerant species, and the remainder of the fauna appeared to indicate very good water quality. The site was assessed as non-impacted.

STREAM SITE: Butternut Creek, Station 08  
 LOCATION: Mt. Upton, New York, 150 meters downstream of Flatiron Road bridge  
 DATE: 03 July 2003  
 SAMPLE TYPE: Kick sample  
 SUBSAMPLE: 100

PLATYHELMINTHES

TURBELLARIA	Planariidae	Undetermined Turbellaria	1
ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	Undetermined Lumbriculidae	14
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	1
	Baetidae	Acentrella sp.	3
	Heptageniidae	Leucrocuta sp.	13
		Stenonema terminatum	1
	Leptophlebiidae	Paraleptophlebia mollis	1
	Ephemerellidae	Drunella cornuta	4
		Serratella deficiens	1
		Serratella sp.	1
PLECOPTERA	Perlidae	Agnetina capitata	8
COLEOPTERA	Psephenidae	Psephenus herricki	7
	Elmidae	Stenelmis crenata	11
TRICHOPTERA	Philopotamidae	Chimarra aterrima?	7
		Chimarra obscura	2
		Dolophilodes sp.	1
	Hydropsychidae	Hydropsyche morosa	9
	Brachycentridae	Brachycentrus appalachia	1
	Leptoceridae	Oecetis avara	1
DIPTERA	Ceratopogonidae	Undetermined Ceratopogonidae	1
	Chironomidae	Thienemannimyia gr. spp.	3
		Cardiocladius albiplumus	1
		Tvetenia vitracies	1
		Polypedilum aviceps	6
		Tanytarsus guerlus gr.	1

SPECIES RICHNESS: 25 (good)  
 BIOTIC INDEX: 3.70 (very good)  
 EPT RICHNESS: 15 (very good)  
 MODEL AFFINITY: 66 (very good)  
 ASSESSMENT: non-impacted

DESCRIPTION: Riffles were sampled 150 meters downstream of the Flatiron Road bridge. The fauna was similar to that found upstream of the bridge, although fewer worms were present. Water quality was similarly assessed as non-impacted.

### FIELD DATA SUMMARY

**STREAM NAME: Butternut Creek**

**DATE SAMPLED: 7/3/2003 & 7/7/2003**

**REACH: Garrattsville to Mt. Upton**

**FIELD PERSONNEL INVOLVED: Bode, Novak, Smith**

STATION	01	02	03	04
ARRIVAL TIME AT STATION	10:30	11:05	11:55	12:35
LOCATION	Garrattsville	New Lisbon	Morris	Below Morris
<b>PHYSICAL CHARACTERISTICS</b>				
Width (meters)	8	8	8	10
Depth (meters)	0.2	0.2	0.2	0.2
Current speed (cm per sec.)	110	100	125	125
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	0	0	20
Rubble (6.35 - 25.4 cm)	40	40	40	20
Gravel (0.2 - 6.35 cm)	30	30	30	20
Sand (0.06 - 2.0 mm)	10	10	10	20
Silt (0.004 - 0.06 mm)	20	20	20	20
Embeddedness (%)	30	20	20	20
<b>CHEMICAL MEASUREMENTS</b>				
Temperature (°C)	18.9	18.1	18.4	19.4
Specific Conductance (umhos)	164	166	169	170
Dissolved Oxygen (mg/l)	10.2	9.6	9.3	9.3
pH	7.4	6.0	6.9	6.9
<b>BIOLOGICAL ATTRIBUTES</b>				
Canopy (%)	50	0	10	10
Aquatic Vegetation				
algae - suspended				
algae - attached, filamentous				
algae - diatoms	X		X	
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	X
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X	X	X	
Megaloptera(dobsonflies,alderflies)	X		X	
Odonata (dragonflies, damselflies)		X		X
Chironomidae (midges)			X	
Simuliidae (black flies)			X	
Decapoda (crayfish)	X	X	X	X
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)			X	X
Other				
<b>FAUNAL CONDITION</b>	Very good	Very good	Very good	Very good

**FIELD DATA SUMMARY**

**STREAM NAME: Butternut Creek**

**DATE SAMPLED: 7/3/2003 & 7/7/2003**

**REACH: Garrattsville to Mt. Upton**

**FIELD PERSONNEL INVOLVED: Bode, Novak, Smith**

<b>STATION</b>	05	06	07	08
<b>ARRIVAL TIME AT STATION</b>	1:00	1:30	10:30	11:25
<b>LOCATION</b>	Gilbertsville	Copes Corner	Mt. Upton	Mt. Upton
<b>PHYSICAL CHARACTERISTICS</b>				
Width (meters)	10	20	15	25
Depth (meters)	0.3	0.2	0.3	0.2
Current speed (cm per sec.)	125	110	125	100
Substrate (%)				
Rock (>25.4 cm, or bedrock)	20	20	0	
Rubble (6.35 - 25.4 cm)	30	30	10	10
Gravel (0.2 - 6.35 cm)	20	20	50	50
Sand (0.06 - 2.0 mm)	10	10	20	20
Silt (0.004 - 0.06 mm)	20	20	20	20
Embeddedness (%)	20	20	20	
<b>CHEMICAL MEASUREMENTS</b>				
Temperature (° C)	22.9	23.2	20.5	20.8
Specific Conductance (umhos)	169	166	147	147
Dissolved Oxygen (mg/l)	8.6	7.8	9.6	9.8
pH	6.9	6.8	6.9	7.3
<b>BIOLOGICAL ATTRIBUTES</b>				
Canopy (%)	30	40	10	50
Aquatic Vegetation				
algae - suspended	X			
algae - attached, filamentous	X	X	X	XX
algae - diatoms			XX	X
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	X
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X		X	X
Megaloptera (dobsonflies, alderflies)	X			
Odonata (dragonflies, damselflies)				X
Chironomidae (midges)				
Simuliidae (black flies)				
Decapoda (crayfish)	X			X
Gammaridae (scuds)				
Mollusca (snails, clams)		X		
Oligochaeta (worms)	X	X	X	X
Other				
<b>FAUNAL CONDITION</b>	Very good	Very good	Good	Good



## APPENDIX I. BIOLOGICAL METHODS FOR KICK SAMPLING

A. Rationale. The use of the standardized kick sampling method provides a biological assessment technique that lends itself to rapid assessments of stream water quality.

B. Site Selection. Sampling sites are selected based on these criteria: (1) The sampling location should be a riffle with a substrate of rubble, gravel, and sand. Depth should be one meter or less, and current speed should be at least 0.4 meters per second. (2) The site should have comparable current speed, substrate type, embeddedness, and canopy cover to both upstream and downstream sites to the degree possible. (3) Sites are chosen to have a safe and convenient access.

C. Sampling. Macroinvertebrates are sampled using the standardized traveling kick method. An aquatic net is positioned in the water at arms' length downstream and the stream bottom is disturbed by foot, so that the dislodged organisms are carried into the net. Sampling is continued for a specified time and for a specified distance in the stream. Rapid assessment sampling specifies sampling 5 minutes for a distance of 5 meters. The net contents are emptied into a pan of stream water. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

D. Sample Sorting and Subsampling. In the laboratory the sample is rinsed with tap water in a U.S. No. 40 standard sieve to remove any fine particles left in the residues from field sieving. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula, rinsed with water, and placed in a petri dish. This portion is examined under a dissecting stereomicroscope and 100 organisms are randomly removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. The total number of organisms in the sample is estimated by weighing the residue from the picked subsample and determining its proportion of the total sample weight.

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species, and the total number of individuals in the subsample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol. Following identification of a subsample, if the results are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

## APPENDIX II. MACROINVERTEBRATE COMMUNITY PARAMETERS

1. Species richness. This is the total number of species or taxa found in the sample. Expected ranges for 100-specimen subsamples of kick samples in most streams in New York State are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted; less than 11, severely impacted.

2. EPT value. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organism subsample. These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). Expected ranges from most streams in New York State are: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

3. Biotic index. The Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage effluent, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each species 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). For purposes of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Values are listed in Hilsenhoff (1987); additional values are assigned by the NYS Stream Biomonitoring Unit. The most recent values for each species are listed in the Quality Assurance document (Bode et al., 1996). Ranges for the levels of impact are: 0-4.50, non-impacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. Percent Model Affinity 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 of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

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Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. NYS DEC technical report, 89 pp.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. *The Great Lakes Entomologist* 20(1): 31-39.

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

Novak, M.A., and R.W. Bode. 1992. Percent model affinity: a new measure of macroinvertebrate community composition. *J. N. Am. Benthol. Soc.* 11(1):80-85.

## APPENDIX III. LEVELS OF WATER QUALITY IMPACT IN STREAMS.

The description of overall stream water quality based on biological parameters uses a four-tiered system of classification. Level of impact is assessed for each individual parameter, and then combined for all parameters to form a consensus determination. Four parameters are used: species richness, EPT value, biotic index, and percent model affinity. The consensus is based on the determination of the majority of the parameters; since parameters measure different aspects of the community, they cannot be expected to always form unanimous assessments. The ranges given for each parameter are based on 100-organism subsamples of macroinvertebrate riffle kick samples, and also apply to most multiplate samples, with the exception of percent model affinity.

### 1. Non-impacted

Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well-represented; the EPT value is greater than 10. 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.

### 2. Slightly impacted

Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

### 3. Moderately impacted

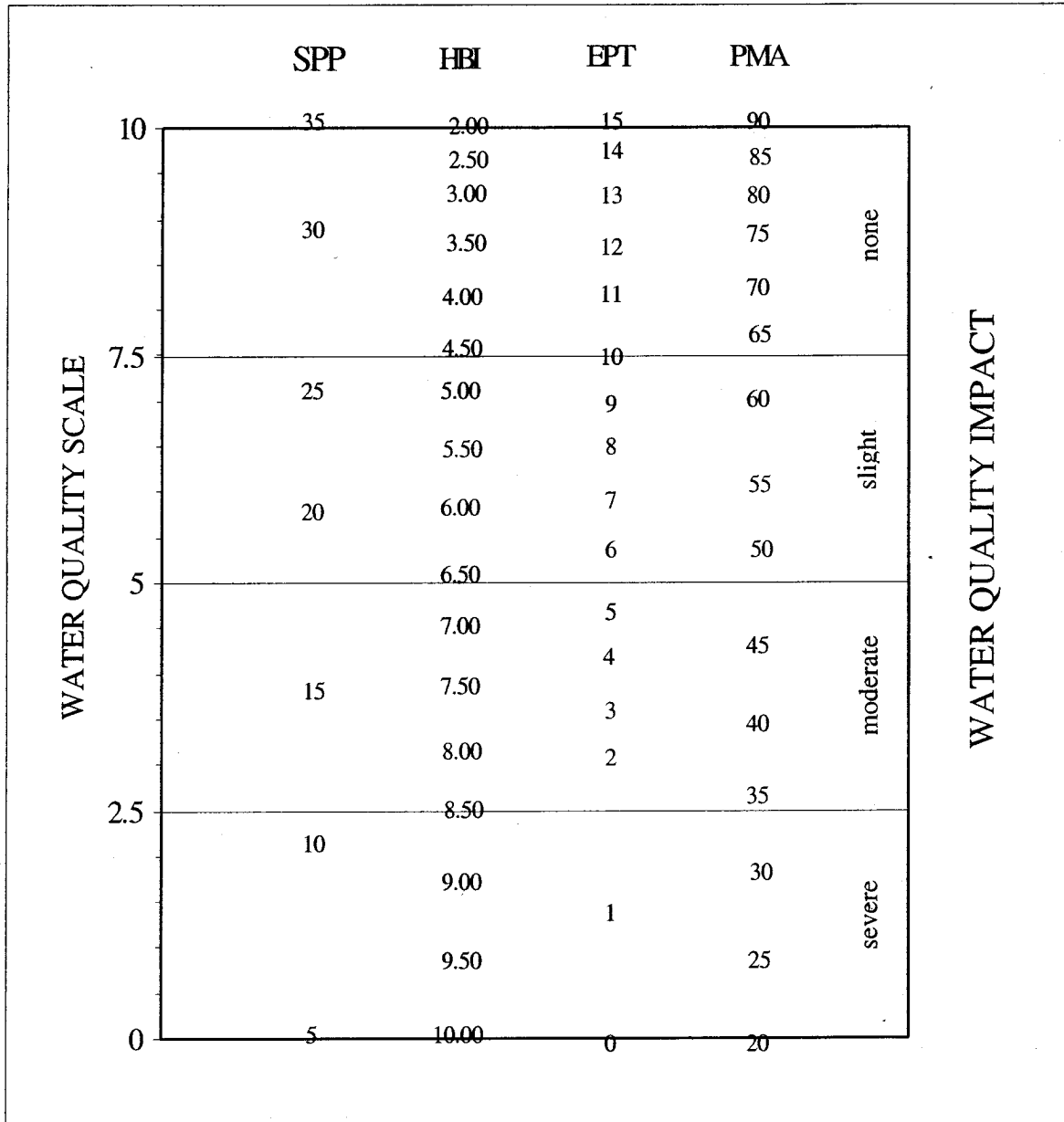
Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. Water quality often is limiting to fish propagation, but usually not to fish survival.

### 4. Severely impacted

Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT value is 0-1. The biotic index value is greater than 8.50. 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.

## APPENDIX IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

The Biological Assessment Profile of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale as shown in the figure below. To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices represents the assessed impact for each site.



APPENDIX V.  
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity#	Diversity*
Non-Impacted	>26	0.00-4.50	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	0-1	<35	0.00-2.00

# Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.

\* Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA  
for navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	EPT Value	Diversity
Non-Impacted	>21	0.00-7.00	>5	>3.00
Slightly Impacted	17-21	7.01-8.00	4-5	2.51-3.00
Moderately Impacted	12-16	8.01-9.00	2-3	2.01-2.50
Severely Impacted	0-11	9.01-10.00	0-1	0.00-2.00



## APPENDIX IX. GLOSSARY

**assessment:** a diagnosis or evaluation of water quality

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

**biomonitoring:** the use of biological indicators to measure water quality

**community:** a group of populations of organisms interacting in a habitat

**drainage basin:** an area in which all water drains to a particular waterbody; watershed

**EPT value:** the number of species of mayflies, stoneflies, and caddisflies in a sample

**facultative:** occurring over a wide range of water quality; neither tolerant nor intolerant of poor water quality

**fauna:** the animal life of a particular habitat

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

**impairment:** a detrimental effect caused by an impact

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

**intolerant:** unable to survive poor water quality

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

**organism:** a living individual

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

**riffle:** wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids

**species richness:** the number of macroinvertebrate species in a sample or subsample

**station:** a sampling site on a waterbody

**survey:** a set of samplings conducted in succession along a stretch of stream

**tolerant:** able to survive poor water quality





## APPENDIX X. METHODS FOR IMPACT SOURCE DETERMINATION

**Definition** Impact Source Determination (ISD) is the procedure for identifying types of impacts that exert deleterious effects on a waterbody. While the analysis of benthic macroinvertebrate communities has been shown to be an effective means of determining severity of water quality impacts, it has been less effective in determining what kind of pollution is causing the impact. Impact Source Determination uses community types or models to ascertain the primary factor influencing the fauna.

**Development of methods** The method found to be most useful in differentiating impacts in New York State streams was the use of community types, based on composition by family and genus. It may be seen as an elaboration of Percent Model Affinity (Novak and Bode, 1992), which is based on class and order. A large database of macroinvertebrate data was required to develop ISD methods. The database included several sites known or presumed to be impacted by specific impact types. The impact types were mostly known by chemical data or land use. These sites were grouped into the following general categories: agricultural nonpoint, toxic-stressed, sewage (domestic municipal), sewage/toxic, siltation, impoundment, and natural. Each group initially contained 20 sites. Cluster analysis was then performed within each group, using percent similarity at the family or genus level. Within each group four clusters were identified, each cluster usually composed of 4-5 sites with high biological similarity. From each cluster a hypothetical model was then formed to represent a model cluster community type; sites within the cluster had at least 50 percent similarity to this model. These community type models formed the basis for Impact Source Determination (see tables following). The method was tested by calculating percent similarity to all the models, and determining which model was the most similar to the test site. Some models were initially adjusted to achieve maximum representation of the impact type. New models are developed when similar communities are recognized from several streams.

**Use of the ISD methods** Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural", lacking an impact. In the graphic representation of ISD, only the highest similarity of each source type is identified. If no model exhibits a similarity to the test data of greater than 50%, the determination is inconclusive. The determination of impact source type is used in conjunction with assessment of severity of water quality impact to provide an overall assessment of water quality.

**Limitations** These methods were developed for data derived from 100-organism subsamples of traveling kick samples from riffles of New York State streams. Application of the methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

NATURAL

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Isonychia</u>	5	5	-	5	20	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	10	10	10	10	5	15	40
HEPTAGENIIDAE	5	10	5	20	10	5	5	5	5	10	10	5	5
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	5	-	-	25	5
EPHEMERELLIDAE	5	5	5	10	-	10	10	30	-	5	-	10	5
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
<u>Psephenus</u>	5	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	5	-	20	5	5	-	5	5	5	5	-	-	-
<u>Promoresia</u>	5	-	-	-	-	-	25	-	-	-	-	-	-
<u>Stenelmis</u>	10	5	10	10	5	-	-	-	10	-	-	-	5
PHILOPOTAMIDAE	5	20	5	5	5	5	5	-	5	5	5	5	5
HYDROPSYCHIDAE	10	5	15	15	10	10	5	5	10	15	5	5	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	5	5	-	-	-	20	-	5	5	5	5	5	-
SIMULIIDAE	-	-	-	5	5	-	-	-	-	5	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
<u>Cardiocladius</u>	-	5	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	5	5	-	-	10	-	-	5	-	-	5	5	5
<u>Eukiefferiella/</u> <u>Tvetenia</u>	5	5	10	-	-	5	5	5	-	5	-	5	5
<u>Parametricnemus</u>	-	-	-	-	-	-	-	5	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	20	-	-	10	20	20	5	-
<u>Polypedilum (all others)</u>	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	5	-	-	5	-	5	5	-	-	-
<u>Optioservus</u>	10	-	-	5	-	-	15	5	-	5
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	15	-	10	15	5	25	5	10	5
PHILOPOTAMIDAE	15	5	10	5	-	25	5	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>										
<u>Orthocladius</u>	10	15	10	5	-	-	-	-	5	5
<u>Eukiefferiella/</u>										
<u>Tvetenia</u>	-	15	10	5	-	-	-	-	5	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Microtendipes</u>	-	-	-	-	-	-	-	-	-	20
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	20	10	5	10	5	5
Tanytarsini	10	10	10	5	20	5	5	10	-	10
TOTAL	100	100	100	100	100	100	100	100	100	100

	MUNICIPAL/INDUSTRIAL								TOXIC					
	A	B	C	D	E	F	G	H	A	B	C	D	E	F
PLATYHELMINTHES	-	40	-	-	-	5	-	-	-	-	-	-	5	-
OLIGOCHAETA	20	20	70	10	-	20	-	-	-	10	20	5	5	15
HIRUDINEA	-	5	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	5	-	-	-	5	-	-	-	5
SPHAERIIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	10	5	10	10	15	5	-	-	10	10	-	20	10	5
GAMMARIDAE	40	-	-	-	15	-	5	5	5	-	-	-	5	5
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	5	-	-	10	5	-	5	5	10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40	10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20	20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	5	10	20	-	5	10	5	5	15	10	25	10	5	10
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	-	-	-	-	-	-	-	-	20	10	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-	-	5	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	-	-	-	10	20	40	10	5	10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-	-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

SEWAGE EFFLUENT, ANIMAL WASTES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-	5	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE	-	-	-	-	-	-	-	-	-	-
Tanypodinae	-	5	-	-	-	-	-	-	5	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	-	10	15	-	-	10	10	-	5	5
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	10	-	-	-	-	-	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	10	-	-	60
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	10	60	-	30	10	5	5
Tanytarsini	10	10	10	10	-	-	-	10	40	-
TOTAL	100	100	100	100	100	100	100	100	100	100

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<u>Optioservus</u>	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	5	10	10	5	20	5	5	10	10	-	5	35	-	5	10
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	30
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	20
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	15
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>															
<u>Orthocladius</u>	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
<u>Eukiefferiella/</u>															
<u>Tvetenia</u>	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
<u>Parametrioctenemus</u>	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100



