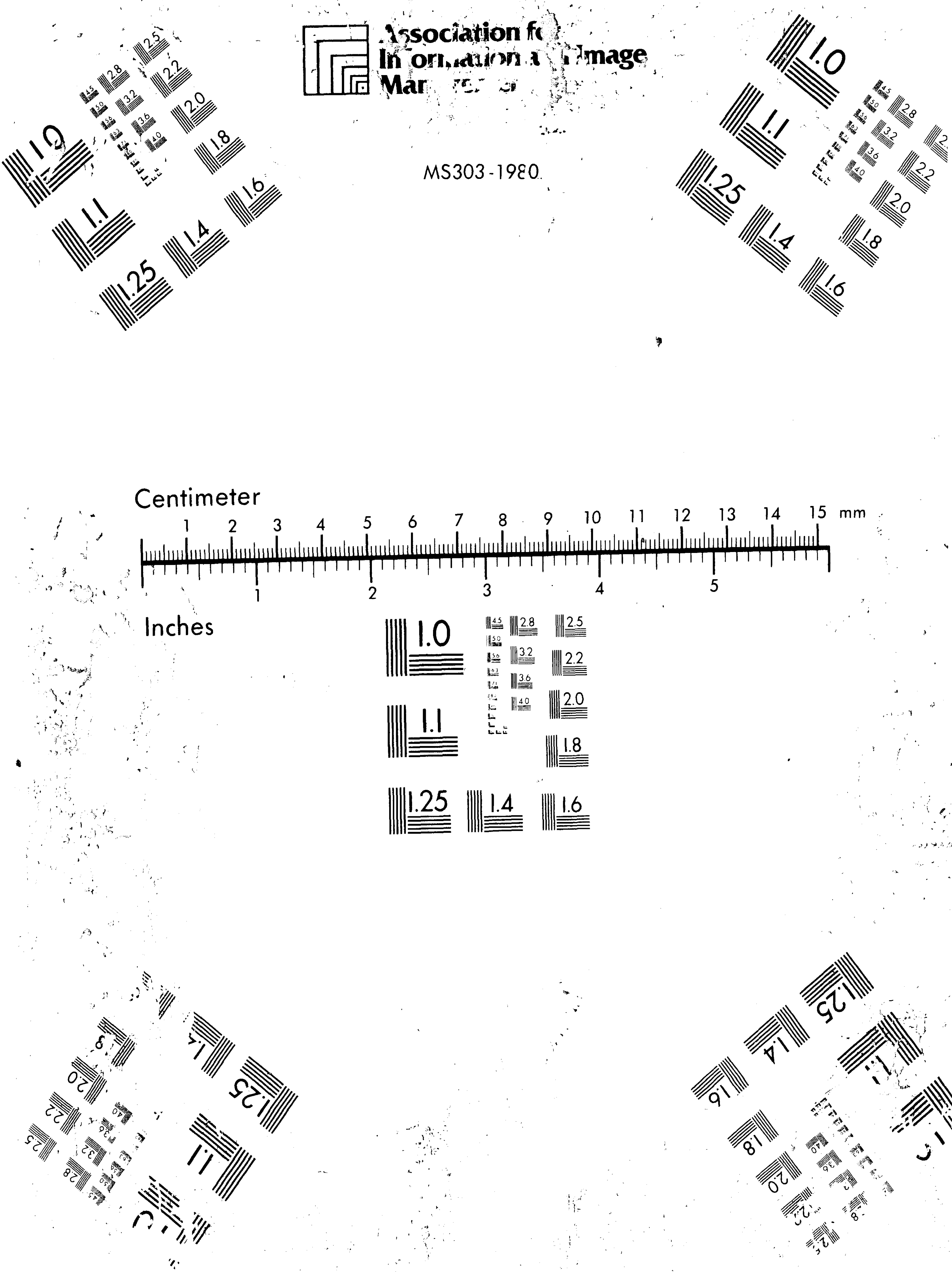
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New York State
Department of Environmental Conservation

Division of Water

Seeley Creek

Biological Assessment

1998 Survey

GEORGE E. PATAKI, *Governor*

JOHN P. CAHILL, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Seeley Creek
Chemung County, New York

Survey date: August 13, 1998
Report date: June 4, 1999

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Bureau of Watershed Assessment and Research
Division of Water
NYS Department of Environmental Conservation
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CONTENTS

Stream: Seeley Creek: Chemung County, New York

Reach: hamlet of Seeley Creek to Southport

Background:

The Stream Biomonitoring Unit conducted a biological survey of Seeley Creek on August 13, 1998. The purpose of the sampling was to assess general water quality and to establish a baseline set of invertebrate data. Traveling kick samples were taken in riffle areas at three sites on Seeley Creek, and one site on Mudlick Creek, a tributary, using methods described in the Quality Assurance document (Bode et al., 1996) 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. Water quality assessments were based on resident macroinvertebrates (aquatic insects, worms, mollusks, crustaceans). Community parameters used in the determination of water quality included species richness, biotic index, EPT richness, and percent model affinity (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 site collection information, including a list of the species and numbers of individuals in the 100-organism subsample.

Results and Conclusions:

1. Water quality in Seeley Creek in the reach from the hamlet of Seeley Creek to Southport was generally good, with non- or slightly impacted water quality at all three sites. Some siltation effects were noted, but these were present both upstream and downstream of the landslide area.

2. Mudlick Creek, a tributary that enters Seeley Creek in the hamlet of Seeley Creek, had slightly impacted water quality. The type of impact is not clear, but does not appear to be the result of livestock wastes entering the stream, which occurs approximately 5 miles upstream of the sampling site.

3. Additional work in this watershed, some of which could be accomplished by interested local groups, should include investigation of Seeley Creek upstream of Station 1. Locating inputs to the mainstem and to Mudlick Creek by walking the stream and by measurement of some chemical parameters, could help to determine the cause of the impacts noted in the current survey.

Discussion:

Water quality in Seeley Creek in the reach from the hamlet of Seeley Creek to Southport was generally good, with non-impacted or slightly impacted water quality at all three sites. Local concerns about this reach stem from the steady erosion of a large embankment into the stream, and the potential for a total collapse of the slope. Approximately 60% of the Seeley Creek watershed lies in Pennsylvania, so discharges into the stream are not known for much of the basin. There is evidence of siltation effects in this reach, as distinguished by impact source determination (Table 1), but these effects were present both upstream and downstream of the landslide area. The ongoing siltation is not enough to diminish water quality. The most downstream site, in the village of Southport (Station 4), had excellent water quality, with a well-balanced community containing the clean-water groups of mayflies, stoneflies, and caddisflies. However, if the entire landslide area collapses, as is thought possible, the effects to at least a short reach of the stream could substantially alter the nature of the stream substrate and flow pattern, and presumably, the invertebrate community.

The most upstream site sampled on Seeley Creek (Station 1) was assessed as slightly impacted, although impact source determination did not clearly identify the type of impact. The sample was dominated by the filter-feeding midge, *Microtendipes pedellus* gr. Most other stream sites in New York State dominated by this midge show slight effects of nutrient enrichment. It is unknown whether Mudlick Creek contributes to water quality at this site.

On the tributary of Mudlick Creek, livestock wastes enter the stream approximately 5 miles upstream of the mouth (R. Kankus, Town of Southport, pers. comm.). While water quality was assessed as slightly impacted at the Mudlick Creek site, the impacts did not appear to be from animal waste. Richness and abundance were relatively low. No stoneflies were noted in the field, and none were present in the 100-organism subsample. Impact source determination indicated a possible toxic effect, but causes of such an effect are not known.

Additional work in this watershed, some of which could be accomplished by interested local groups, should include investigation of Seeley Creek upstream of Station 1, perhaps into Pennsylvania. The state of Pennsylvania has not surveyed the portion of the watershed that lies within its boundaries (Rod Kime, PA DEP, pers. comm.). Locating inputs to the mainstem and to Mudlick Creek by walking the stream and by measurement of some chemical parameters, could help to determine the cause of the impacts noted in the current survey.

Literature cited

Bode, R.W., M.A. Novak, and L.E. Abele. 1996. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation, Albany, NY. NYS DEC Technical Report, 89 pages.

Overview of field data

On the date of sampling, August 13, 1998, Seeley Creek at the sites sampled was 8 - 40 meters wide, 0.1-0.2 meters deep in riffles, and had current speeds of 67 - 83 cm/sec in riffles. Dissolved oxygen was 7.7-8.7 mg/l, specific conductance was 314-350 µmhos, pH was 7.9-8.4, and the temperature was 18.0-21.7 °C (64-71 °F). Measurements for each site and for the Mudlick Creek location are found on the field data summary sheets.

Figure 1. Biological Assessment Profile of index values, Seeley Creek, 1998. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for more complete explanation.

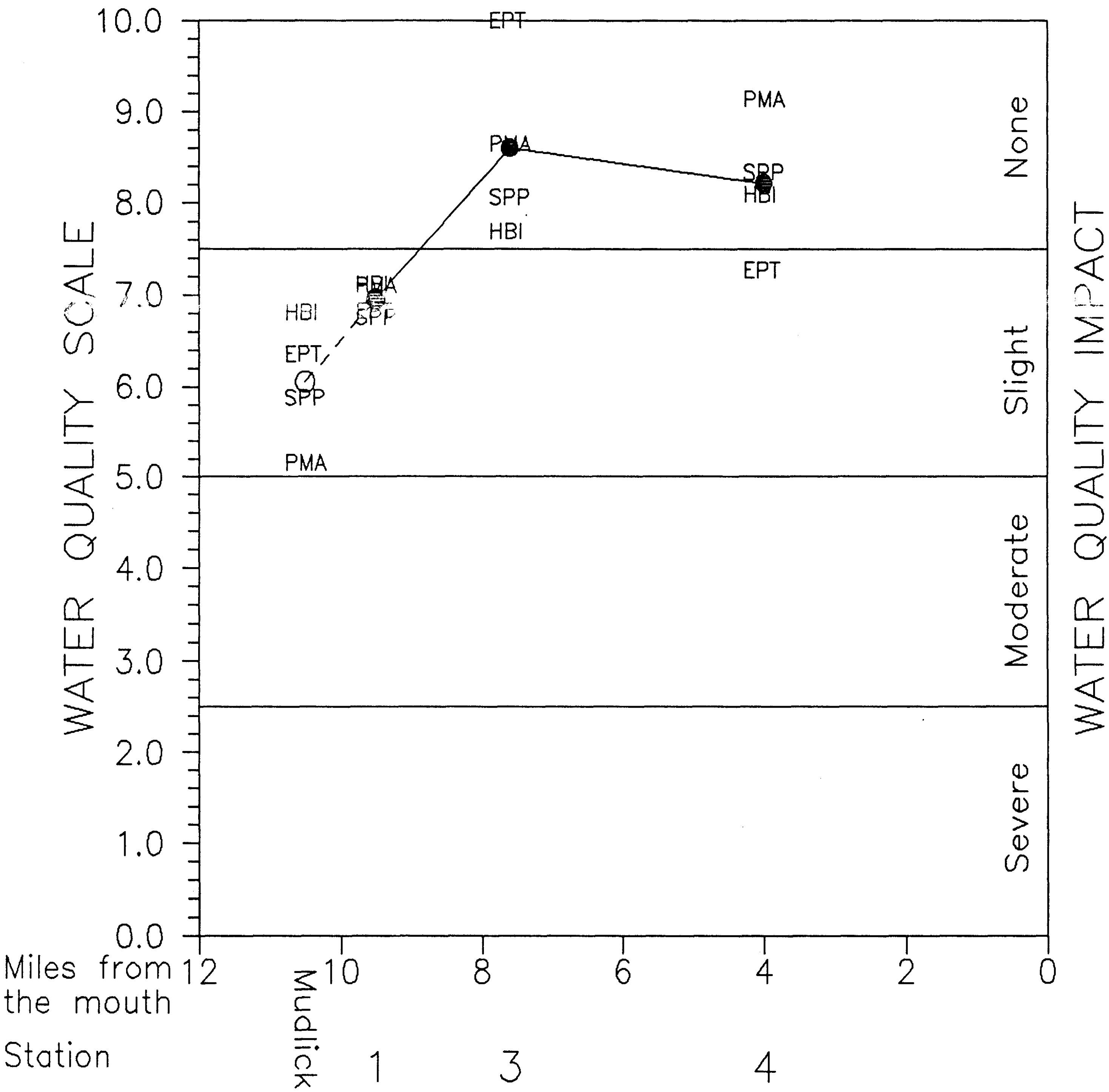


Table 1. Impact Source Determination results for Seeley Creek. Numbers represent similarity to community type models for each impact category. The highest similarity at each station is highlighted. Similarities below 50% are less conclusive. See Appendix X for more complete explanation of ISD.

	STATION			
Community Type	1	Mudlick	3	4
Natural: minimal human impacts	43	52	59	41
Nutrient additions; mostly nonpoint, agricultural	38	45	47	28
Toxic: industrial, municipal, or urban run-off	37	50	38	29
Organic: sewage effluent, animal wastes	30	39	35	30
Complex: municipal/industrial	27	42	36	24
Siltation	36	43	58	47
Impoundment	31	42	39	28

TABLE 2. STATION LOCATIONS FOR SEELEY CREEK AND MUDLICK CREEK, A TRIBUTARY, CHEMUNG COUNTY, NEW YORK (see map).

STATION	LOCATION
01	Seeley Creek 200 meters below Rt. 328 bridge 9.5 miles above the mouth latitude/longitude: 42°00'53"; 76°53'36"
03	Webb Mills 10 meters below Pennsylvania Ave. bridge 7.6 miles above the mouth latitude/longitude: 42°02'04"; 76°52'36"
04	Southport 100 meters below Rt. 14 bridge 4.0 miles above the mouth latitude/longitude: 42°03'10"; 76°49'19"
Mudlick Creek (SEEL 02)	Seeley Creek 5 meters below Kinner Hill Rd. bridge 0.5 miles above the mouth latitude/longitude: 42°01'03"; 76°54'08"

Figure 2.	Site Overview Map	Seeley Creek

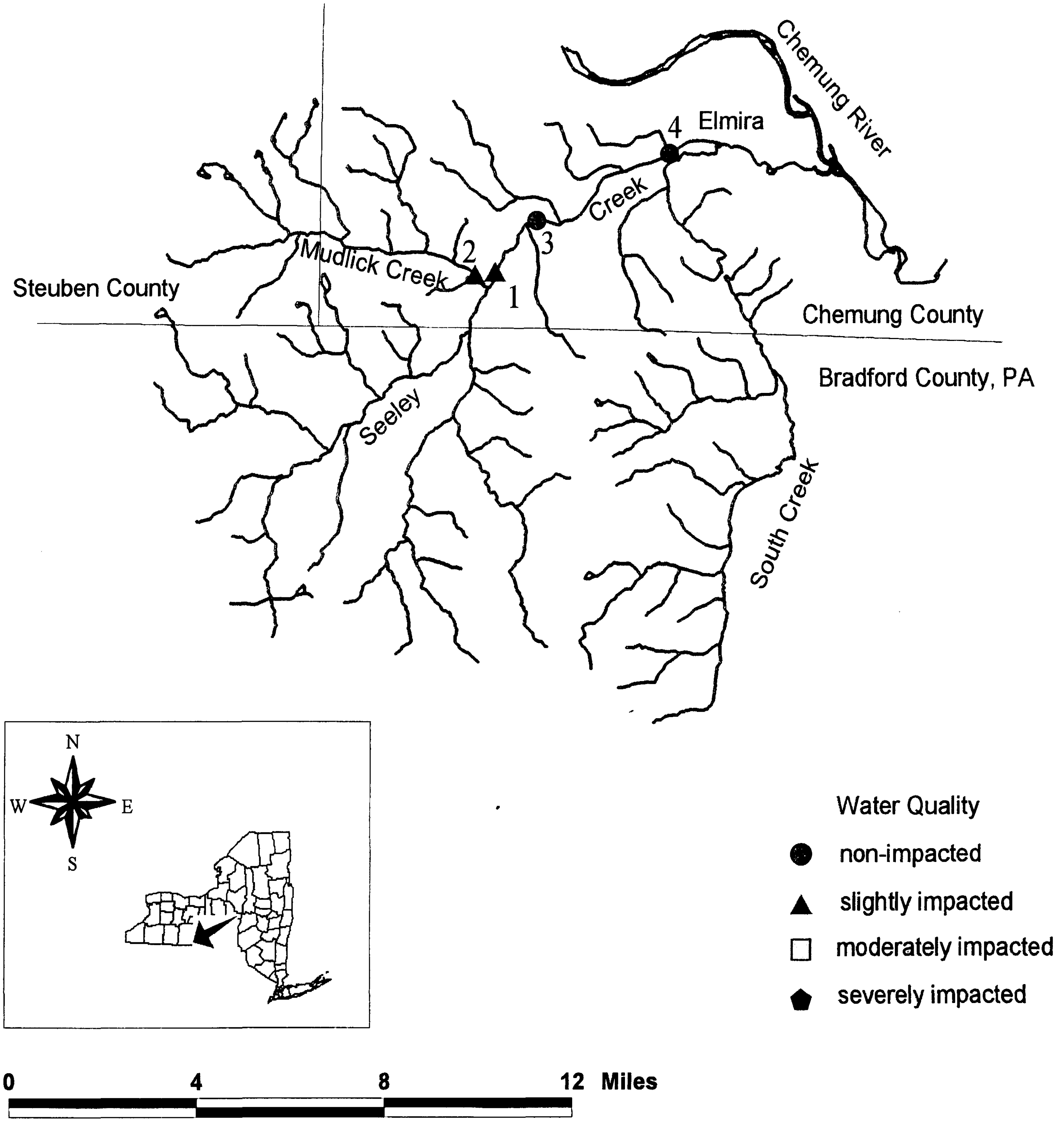


Figure 3a	Site Location Map	Seeley Creek

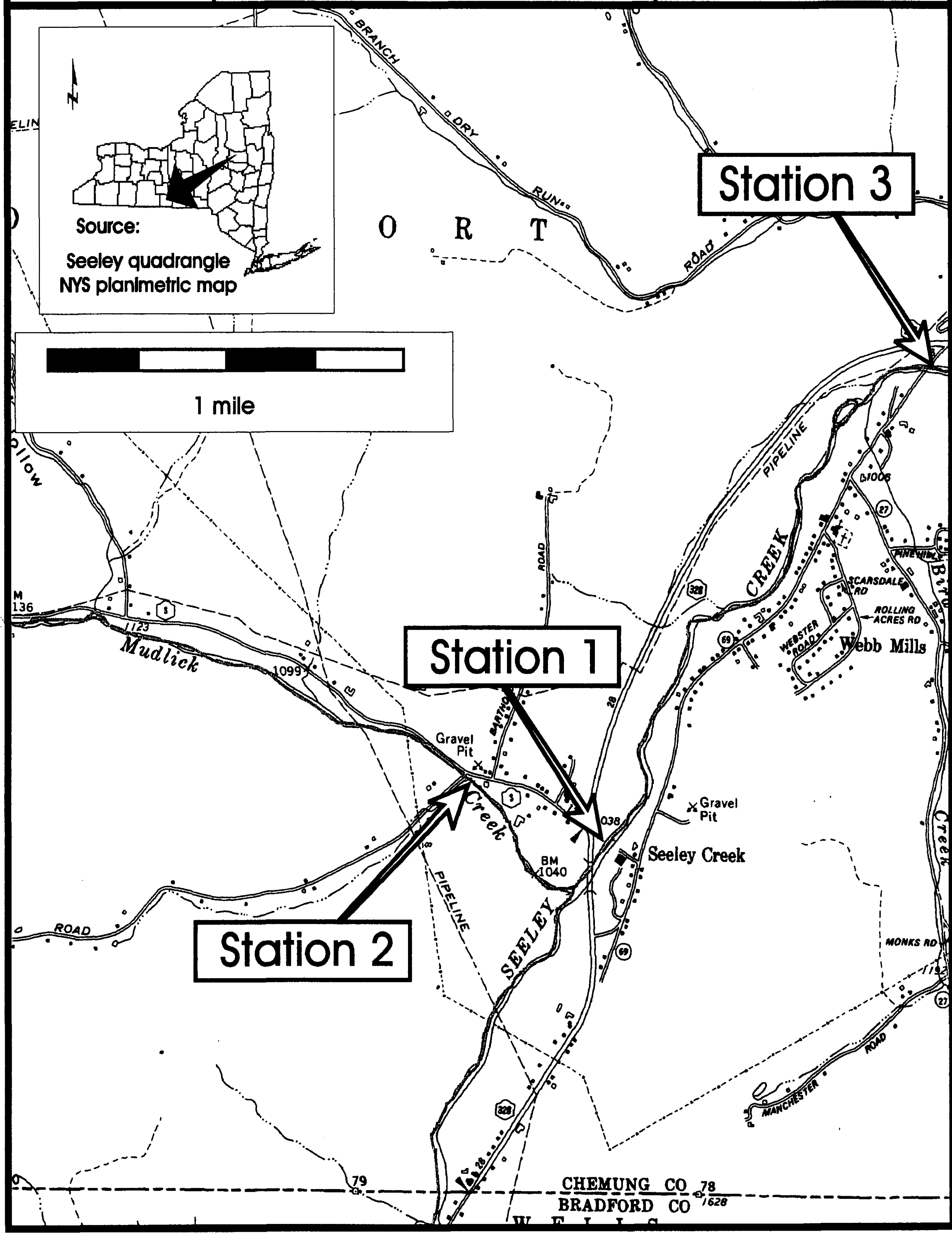


Figure 3b	Site Location Map	Seeley Creek

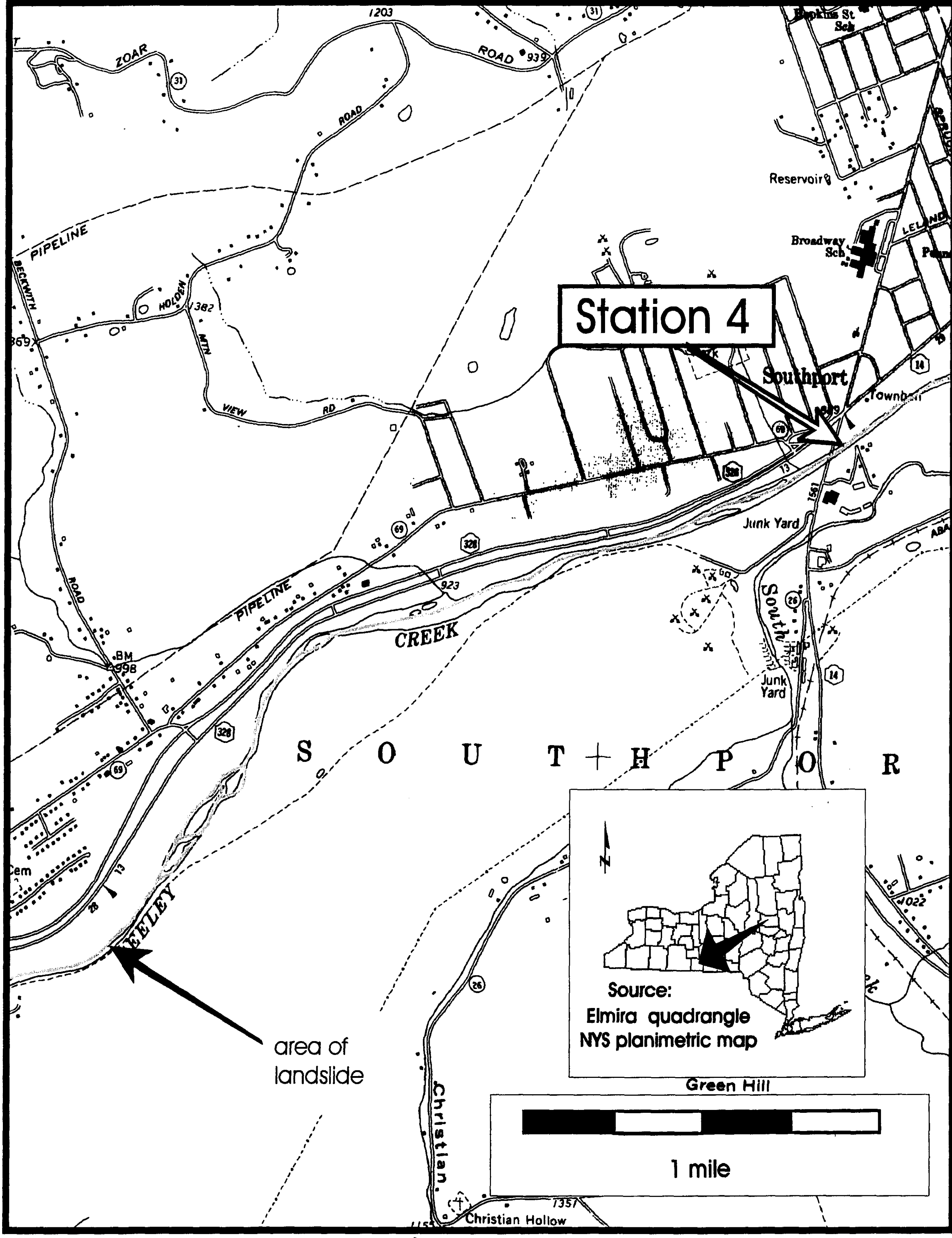


TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN SEELEY CREEK, CHEMUNG COUNTY, NEW YORK, AUGUST 13, 1998.

PLATYHELMINTHES
 TURBELLARIA
  Undetermined Turbellaria
ANNELIDA
 OLIGOCHAETA
  Naididae
   Nais sp.
ARTHROPODA
 INSECTA
  EPHEMEROPTERA
   Isonychiidae
    Isonychia bicolor
   Baetidae
    Baetis flavistriga
    Baetis intercalaris
    Undetermined Baetidae
   Heptageniidae
    Leucrocuta sp.
    Stenonema terminatum
    Stenonema vicarium
    Stenonema sp.
   Ephemerellidae
    Serratella deficiens
    Serratella sp.
   Tricorythidae
    Tricorythodes sp.
   Caenidae
    Caenis sp.
  ODONATA
   Gomphidae
    Ophiogomphus sp.
    Undetermined Gomphidae
  PLECOPTERA
   Perlidae
    Agnetina capitata
    Neoperla sp.
  COLEOPTERA
   Dytiscidae
    Laccophilus sp.
   Elmidae
    Optioservus sp.
    Stenelmis crenata
    Stenelmis sp.
  MEGALOPTERA
   Corydalidae
    Corydalus cornutus
   Sialidae
    Sialis sp.
  TRICHOPTERA
   Philopotamidae
    Chimarra obscura
   Polycentropodidae
    Polycentropus sp.
   Hydropsychidae
    Cheumatopsyche sp.
    Hydropsyche bronta
    Hydropsyche morosa
    Hydropsyche slossonae
    Hydropsyche sparna
  DIPTERA
   Tipulidae
    Hexatoma sp.
   Athericidae
    Atherix sp.
   Empididae
    Hemerodromia sp.
   Chironomidae
    Tanypodinae
     Thienemannimyia gr. spp.
    Diamesinae
     Potthastia gaedii
    Orthocladiinae
     Cardiocladius obscurus
     Cricotopus bicinctus
     Cricotopus trifascia gr.
     Cricotopus vierriensis
     Limnophyes sp.
     Parametriocnemus lundbecki
     Paratrichocladius sp.
     Thienemanniella xena?
    Chironominae
     Chironomini
      Cryptochironomus fulvus gr.
      Microtendipes pedellus gr.
      Polypedilum aviceps
      Polypedilum convictum
      Polypedilum scalaenum gr.
     Tanytarsini
      Rheotanytarsus exiguus gr.
      Tanytarsus guerlus gr.

STREAM SITE:	Seeley Creek Station 1
LOCATION:	hamlet of Seeley Creek, below Rt. 328 bridge
DATE:	August 13, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	3
	Baetidae	Baetis flavistriga	7
		Baetis intercalaris	1
	Heptageniidae	Stenonema sp.	6
	Caenidae	Caenis sp.	2
ODONATA	Gomphidae	Ophiogomphus sp.	1
PLECOPTERA	Perlidae	Agnetina capitata	1
COLEOPTERA	Elmidae	Optioservus sp.	1
		Stenelmis sp.	1
MEGALOPTERA	Corydalidae	Corydalus cornutus	1
TRICHOPTERA	Hydropsychidae	Hydropsyche bronta	5
		Hydropsyche morosa	1
		Hydropsyche slossonae	5
DIPTERA	Tipulidae	Hexatoma sp.	9
	Empididae	Hemerodromia sp.	1
	Chironomidae	Thienemannimyia gr. spp.	16
		Cardiocladius obscurus	1
		Cricotopus bicinctus	2
		Parametriocnemus lundbecki	1
		Paratrichocladius sp.	4
		Microtendipes pedellus gr.	23
		Polypedilum aviceps	5
		Polypedilum convictum	1
		Rheotanytarsus exiguus gr.	2

SPECIES RICHNESS	24 (good)
BIOTIC INDEX	4.81 (good)
EPT RICHNESS	9 (good)
MODEL AFFINITY	62 (good)
ASSESSMENT	slightly impacted

DESCRIPTION

Water quality was assessed as slightly impacted at this site, the most upstream location sampled. Approximately 60% of the Seeley Creek watershed lies in Pennsylvania, in an area of relatively little agriculture. Midges were dominant in the 100-organism subsample, and their abundance had been noted in the field assessment. Impact source determination did not clearly indicate a particular type of impact.

STREAM SITE:	Seeley Creek Station 2
LOCATION:	Mudlick Creek, below Kinner Hill Rd. bridge
DATE:	August 13, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Naididae	Nais sp.	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	4
		Baetis intercalaris	3
	Heptageniidae	Stenonema sp.	4
COLEOPTERA	Elmidae	Stenelmis sp.	2
TRICHOPTERA	Polycentropodidae	Polycentropus sp.	2
	Hydropsychidae	Cheumatopsyche sp.	3
		Hydropsyche bronta	4
		Hydropsyche slossonae	6
		Hydropsyche sparna	2
DIPTERA	Tipulidae	Hexatoma sp.	3
	Empididae	Hemerodromia sp.	3
	Chironomidae	Thienemannimyia gr. spp.	18
		Cricotopus trifascia gr.	4
		Cricotopus vierriensis	1
		Paratrichocladius sp.	2
		Cryptochironomus fulvus gr.	1
		Microtendipes pedellus gr.	4
		Polypedilum aviceps	23
		Polypedilum convictum	4
		Rheotanytarsus exiguus gr.	6

SPECIES RICHNESS	21 (good)
BIOTIC INDEX	5.05 (good)
EPT RICHNESS	8 (good)
MODEL AFFINITY	50 (good)
ASSESSMENT	slightly impacted

DESCRIPTION

This location was sampled because of known occurrences of livestock access to the stream, approximately 5 miles upstream. While a clean-water midge, *Polypedilum aviceps*, was dominant in the subsample, another midge, *Thienemannimyia* group, often associated with toxic situations was also present. Overall, richness and abundance were lower than expected for a non-impacted site. However, no effects of livestock wastes were evident in the composition of the invertebrate community. Impact source determination indicated a possible toxic effect, but no source is known. Water quality was assessed as slightly impacted.

STREAM SITE:	Seeley Creek Station 3
LOCATION:	Webb Mills, below Pennsylvania Ave. bridge
DATE:	August 13, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES			
TURBELLARIA		Undetermined Turbellaria	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	9
	Baetidae	Baetis flavistriga	2
		Undetermined Baetidae	1
	Heptageniidae	Leucrocuta sp.	1
		Stenonema vicarium	6
		Stenonema sp.	11
	Ephemerellidae	Serratella deficiens	3
		Serratella sp.	1
	Tricorythidae	Tricorythodes sp.	2
	Caenidae	Caenis sp.	6
ODONATA	Gomphidae	Undetermined Gomphidae	1
PLECOPTERA	Perlidae	Agnetina capitata	1
		Neoperla sp.	1
COLEOPTERA	Elmidae	Stenelmis crenata	1
TRICHOPTERA	Philopotamidae	Chimarra obscura	1
	Hydropsychidae	Cheumatopsyche sp.	4
		Hydropsyche bronta	7
		Hydropsyche slossonae	6
DIPTERA	Tipulidae	Hexatoma sp.	1
	Chironomidae	Thienemannimyia gr. spp.	15
		Potthastia gaedii	1
		Cricotopus bicinctus	3
		Microtendipes pedellus gr.	1
		Polypedilum aviceps	7
		Polypedilum convictum	1
		Rheotanytarsus exiguus gr.	3
		Tanytarsus guerlus gr.	3

SPECIES RICHNESS	28 (excellent)
BIOTIC INDEX	4.31 (excellent)
EPT RICHNESS	16 (excellent)
MODEL AFFINITY	76 (excellent)
ASSESSMENT	non-impacted

DESCRIPTION

Water quality at this location was determined to be non-impacted. The clean-water groups of mayflies, stoneflies, and caddisflies were abundant and balanced. Impact source determination, while indicating a community most similar to natural communities, did show some influence of siltation.

STREAM SITE:	Seeley Creek Station 4
LOCATION:	Southport, below Rt. 14 bridge
DATE:	August 13, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA
INSECTA

EPHEMEROPTERA	Isonychiidae	Isonychia bicolor	2
	Heptageniidae	Stenonema terminatum	5
		Stenonema vicarium	30
		Stenonema sp.	3
	Ephemerellidae	Serratella deficiens	1
		Serratella sp.	1
	Tricorythidae	Tricorythodes sp.	4
	Caenidae	Caenis sp.	1
ODONATA	Gomphidae	Ophiogomphus sp.	1
COLEOPTERA	Dytiscidae	Laccophilus sp.	1
	Elmidae	Stenelmis sp.	2
MEGALOPTERA	Sialidae	Sialis sp.	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	3
		Hydropsyche bronta	5
DIPTERA	Tipulidae	Hexatoma sp.	3
	Athericidae	Atherix sp.	5
	Empididae	Hemerodromia sp.	1
	Chironomidae	Thienemannimyia gr. spp.	9
		Potthastia gaedii	1
		Cardiocladius obscurus	1
		Cricotopus bicinctus	4
		Cricotopus vierriensis	2
		Limnophyes sp.	1
		Parametriocnemus lundbecki	2
		Thienemanniella xena?	1
		Polypedilum aviceps	5
		Polypedilum convictum	1
		Polypedilum scalaenum gr.	1
		Tanytarsus guerlus gr.	2

SPECIES RICHNESS	29 (excellent)
BIOTIC INDEX	3.91 (excellent)
EPT RICHNESS	10 (good)
MODEL AFFINITY	81 (excellent)
ASSESSMENT	non-impacted

DESCRIPTION

This site, located below the area of the landslide, shows no more indication of siltation problems than the location immediately upstream. The landslide area is most likely contributing material to the stream, but the entire reach in New York may be prone to sedimentation. If the bank were to collapse entirely, however, the effect could be dramatic for the stream reach directly downstream.

LABORATORY DATA SUMMARY

STREAM NAME: Seeley Creek
DRAINAGE: 05 (Chemung)
DATE SAMPLED: 08/13/1998
COUNTY: Chemung
SAMPLING METHOD: Traveling kick

STATION LOCATION	01 Seeley Creek	03 Webb Mills	04 Southport	
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Microtendipes pedellus gr. 23% facultative midge	Thienemannimyia gr. spp. 15% facultative midge	Stenonema vicarium 30% intolerant mayfly	
Intolerant = not tolerant of poor water quality; Facultative = occurring over a wide range of water quality; Tolerant = tolerant of poor water quality. 2.	Thienemannimyia gr. spp. 16% facultative midge	Stenonema sp. 11% intolerant mayfly	Thienemannimyia gr. spp. 9% facultative midge	
3.	Hexatoma sp. 9% intolerant crane fly	Isonychia bicolor 9% intolerant mayfly	Stenonema terminatum 5% intolerant mayfly	
4.	Baetis flavistriga 7% intolerant mayfly	Hydropsyche bronta 7% facultative caddisfly	Hydropsyche bronta 5% facultative caddisfly	
5.	Stenonema sp. 6% intolerant mayfly	Polypedilum aviceps 7% intolerant midge	Polypedilum aviceps 5% intolerant midge	
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	55 (9)	34 (8)	30 (12)	
Trichoptera (caddisflies)	11 (3)	18 (4)	8 (2)	
Ephemeroptera (mayflies)	19 (5)	42 (10)	47 (8)	
Plecoptera (stoneflies)	1 (1)	2 (2)	0 (0)	
Coleoptera (beetles)	2 (2)	1 (1)	3 (2)	
Oligochaeta (worms)	0 (0)	0 (0)	0 (0)	
Other (**)	12 (4)	3 (3)	12 (5)	
TOTAL	100 (24)	100 (28)	100 (29)	
SPECIES RICHNESS	24	28	29	
HBI INDEX	4.81	4.31	3.91	
EPT RICHNESS	9	16	10	
PERCENT MODEL AFFINITY	62	76	81	
FIELD ASSESSMENT	non-impacted	non-impacted	non-impacted	
OVERALL ASSESSMENT	slightly impacted	non-impacted	non-impacted	

LABORATORY DATA SUMMARY

STREAM NAME: Mudlick Creek | **DRAINAGE: 05 (Chemung)**
DATE SAMPLED: 08/13/1998 | **COUNTY: Chemung**
SAMPLING METHOD: Traveling kick

STATION LOCATION	02 Mudlick Creek			
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Polypedilum aviceps 23% intolerant midge			
Intolerant = not tolerant of poor water quality; Facultative = occurring over a wide range of water quality; Tolerant = tolerant of poor water quality. 2.	Thienemannimyia gr. spp. 18% facultative midge			
3.	Rheotanytarsus exiguus gr. 6% facultative midge			
4.	Hydropsyche slossonae 6% intolerant caddisfly			
5.	Baetis flavistriga 4% intolerant mayfly			
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	63 (9)			
Trichoptera (caddisflies)	17 (5)			
Ephemeroptera (mayflies)	11 (3)			
Plecoptera (stoneflies)	0 (0)			
Coleoptera (beetles)	2 (1)			
Oligochaeta (worms)	1 (1)			
Other (**)	6 (2)			
TOTAL	100 (21)			
SPECIES RICHNESS	21			
HBI INDEX	5.05			
EPT RICHNESS	8			
PERCENT MODEL AFFINITY	50			
FIELD ASSESSMENT	slightly impacted			
OVERALL ASSESSMENT	slightly impacted			

FIELD DATA SUMMARY				
STREAM NAME: Seeley Creek REACH: Seeley Creek to Southport DATE SAMPLED: 08/13/1998 FIELD PERSONNEL INVOLVED: Novak, Myers, Andrews				
STATION	01	03	04	
ARRIVAL TIME AT STATION	10:15	11:30	12:05	
LOCATION	Seeley Creek; Rt. 328 bridge	Webb Mills; Penn. Ave. bridge	Sothport; below Rt. 14 br.	
PHYSICAL CHARACTERISTICS				
Width (meters)	10	8	40	
Depth (meters)	0.1	0.1	0.2	
Current speed (cm per sec.)	67	83	67	
Substrate (%)				
rock (> 10 in., or bedrock)		10		
rubble (2.5 - 10 in.)	40	40	30	
gravel (0.08 - 2.5 in.)	30	20	30	
sand (0.06 - 2.0 mm)	20	20	20	
silt (0.004 - 0.06 mm)	10	10	20	
clay (< 0.004 mm)				
Embeddedness (%)	20	20	20	
CHEMICAL MEASUREMENTS				
temperature (° C)	18.0	20.2	21.7	
specific conductance (μmhos)	314	347	350	
D.O. (mg per l)	8.5	7.7	8.7	
pH	8.0	7.9	8.4	
BIOLOGICAL ATTRIBUTES				
canopy (%)	0	5	5	
Aquatic Vegetation				
algae - suspended in water column				
algae - attached, filamentous	present		abundant	
algae - diatoms		present		
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	
Plecoptera (stoneflies)	X	X		
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)	X	X	X	
Megaloptera (dobsonflies, alderflies)				
Odonata (dragonflies, damselflies)			X	
Chironomidae (midges)	X	X		
Simuliidae (black flies)			X	
Decapoda (crayfish)				
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X			
FIELD ASSESSMENT	non	non	non	

FIELD DATA SUMMARY				
STREAM NAME: Mudlick Creek, Seeley Cr. trib. REACH: vicinity of Seeley Creek — DATE SAMPLED: 08/13/1998 FIELD PERSONNEL INVOLVED: Novak, Myers, Andrews				
STATION	02			
ARRIVAL TIME AT STATION	11:00			
LOCATION	5 m below Kinner Hill Rd.			
PHYSICAL CHARACTERISTICS				
Width (meters)	3			
Depth (meters)	0.1			
Current speed (cm per sec.)	67			
Substrate (%)				
rock (> 10 in., or bedrock)	10			
rubble (2.5 - 10 in.)	40			
gravel (0.08 - 2.5 in.)	20			
sand (0.06 - 2.0 mm)	20			
silt (0.004 - 0.06 mm)	10			
clay (< 0.004 mm)				
Embeddedness (%)	20			
CHEMICAL MEASUREMENTS				
temperature (° C)	19.5			
specific conductance (μmhos)	237			
D.O. (mg per l)	9.1			
pH	8.4			
BIOLOGICAL ATTRIBUTES				
canopy (%)	50			
Aquatic Vegetation				
algae - suspended in water column				
algae - attached, filamentous				
algae - diatoms				
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X			
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X			
Coleoptera (beetles)				
Megaloptera (dobsonflies, alderflies)	X			
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X			
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)	X			
Other	X			
FIELD ASSESSMENT	slt			

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 to which rose bengal stain has been added.

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 and placed in a petri dish with alcohol. This portion is examined under a dissecting stereomicroscope and 100 organisms are removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. 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.

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 sample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol.

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.

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 excellent 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

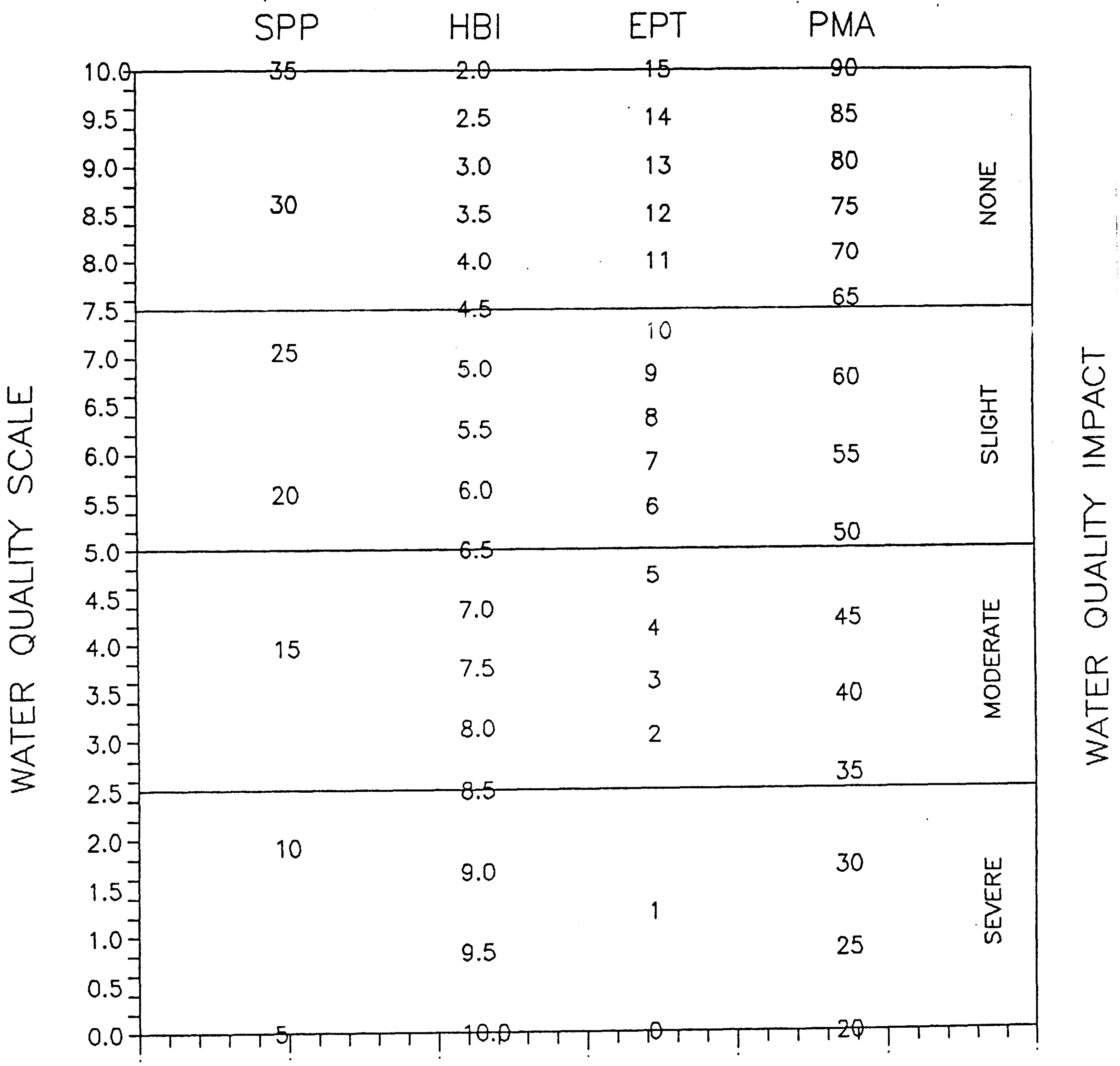
Indices reflect fair water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50. 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 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 is represented by a circle; this value is used for graphing trends between sites, and 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.

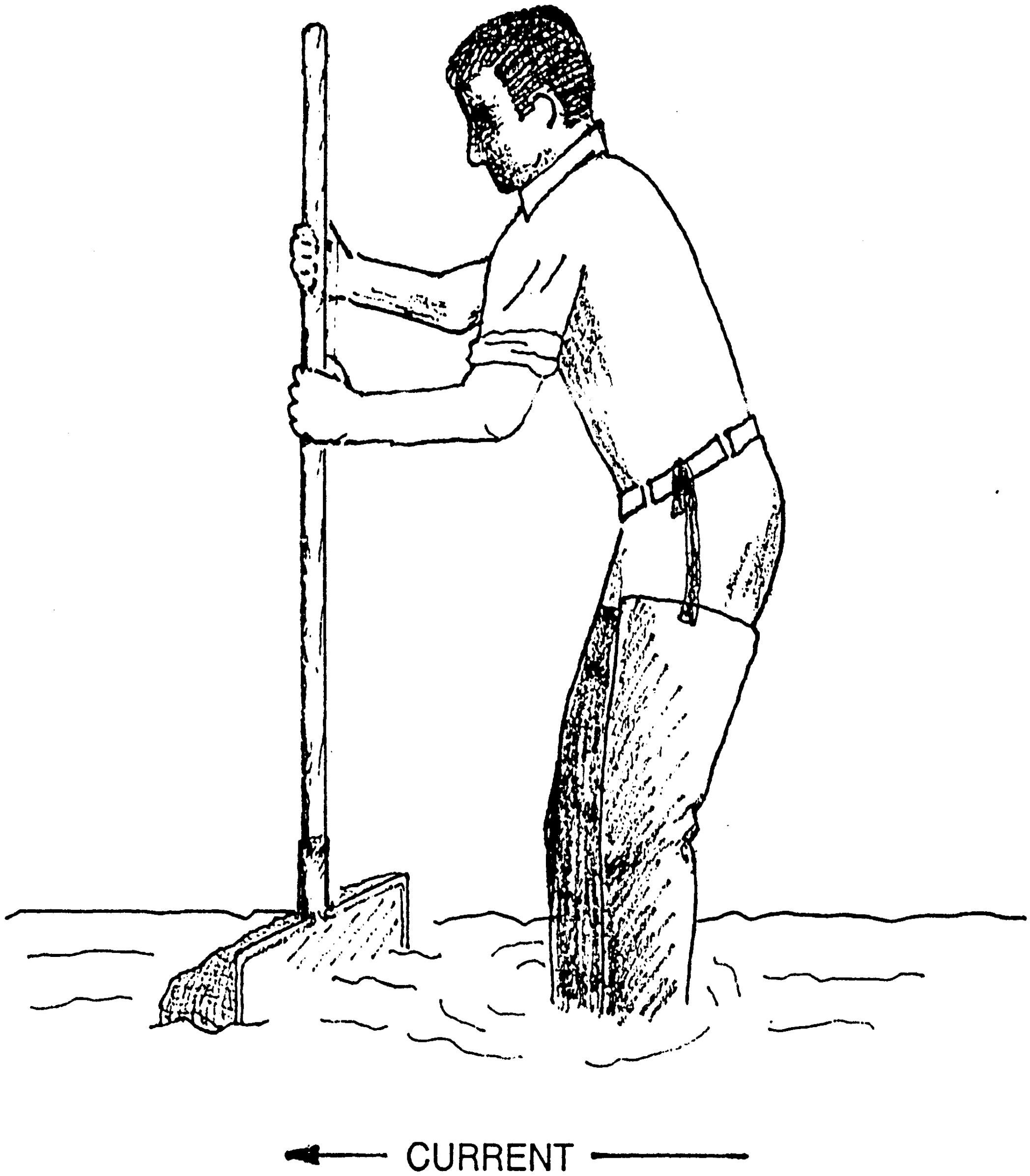
WATER QUALITY ASSESSMENT CRITERIA

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 VI.

THE TRAVELING KICK SAMPLE

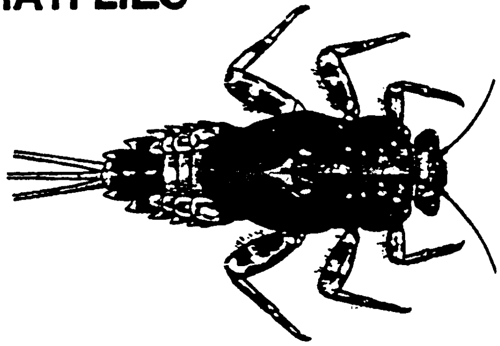


← CURRENT

Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current in the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

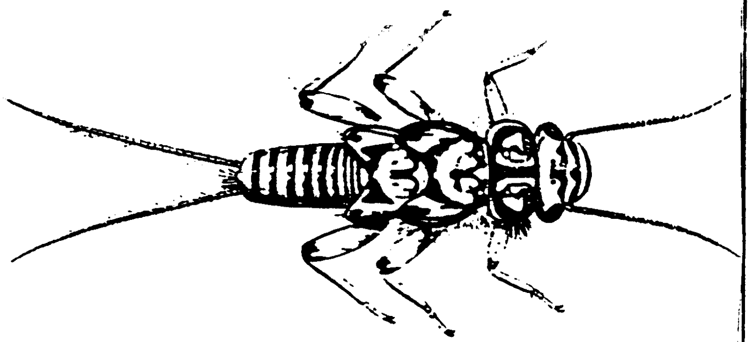
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

MAYFLIES



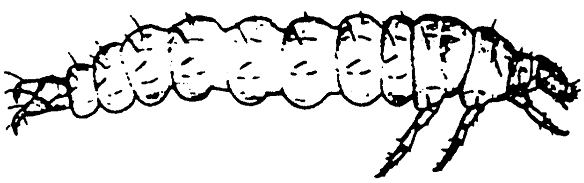
Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.

STONEFLIES



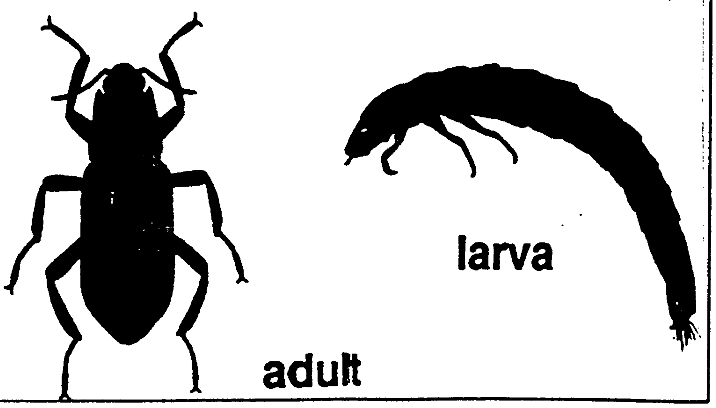
Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained for several months.

CADDISFLIES



Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in recovery zones below sewage discharges.

BEETLES



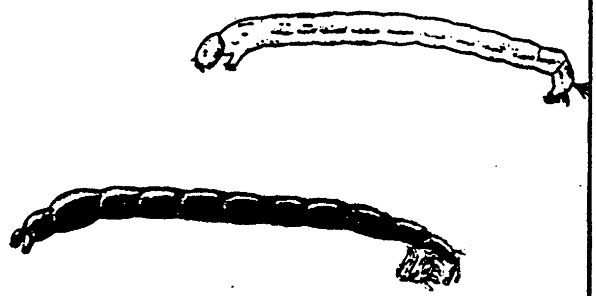
The most common beetles in streams are riffle beetles and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

Illustrations by Arwin Provonsha
In McCafferty: Aquatic Entomology
• 1983 Boston: Jones & Bartlett Publishers. Reprinted by permission.

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

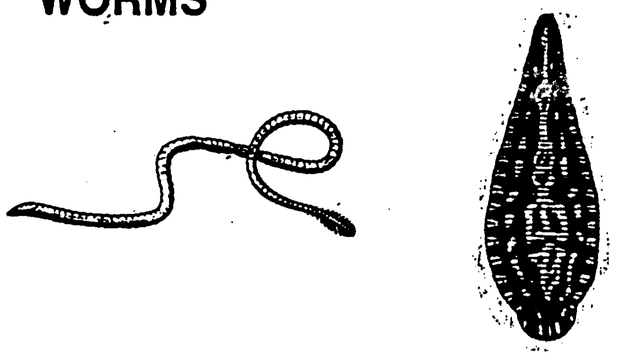
MIDGES

Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution; most of these are red and are called "bloodworms". Other species filter suspended food particles, and are numerous in sewage recovery zones.



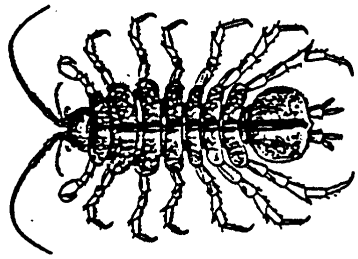
WORMS

The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution indicators. Many leeches are also tolerant of poor water quality.



SOWBUGS

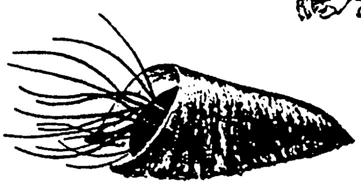
Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. When numerous they can indicate a stream segment in the recovery stage of sewage pollution.



BLACK FLIES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are numerous in the decomposition and recovery zones of sewage pollution, while others are intolerant of pollutants.

larva



pupa

APPENDIX VIII. THE RATIONALE OF BIOLOGICAL MONITORING

Biological monitoring as applied here refers to the use of resident benthic macroinvertebrate communities as indicators of water quality. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit aquatic habitats; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans.

Concept

Nearly all streams are inhabited by a community of benthic macroinvertebrates. The species comprising the community each occupy a distinct niche defined and limited by a set of environmental requirements. The composition of the macroinvertebrate community is thus determined by many factors, including habitat, food source, flow regime, temperature, and water quality. The community is presumed to be controlled primarily by water quality if the other factors are determined to be constant or optimal. Community components which can change with water quality include species richness, diversity, balance, abundance, and presence/absence of tolerant or intolerant species. Various indices or metrics are used to measure these community changes. Assessments of water quality are based on metric values of the community, compared to expected metric values.

Advantages

The primary advantages to using macroinvertebrates as water quality indicators are:

1) they are sensitive to environmental impacts
2) they are less mobile than fish, and thus cannot avoid discharges
3) they can indicate effects of spills, intermittent discharges, and lapses in treatment
4) they are indicators of overall, integrated water quality, including synergistic effects and substances lower than detectable limits
5) they are abundant in most streams and are relatively easy and inexpensive to sample
6) they are able to detect non-chemical impacts to the habitat, such as siltation or thermal changes
7) they are vital components of the aquatic ecosystem and important as a food source for fish
8) they are more readily perceived by the public as tangible indicators of water quality
9) they can often provide an on-site estimate of water quality
10) they can often be used to identify specific stresses or sources of impairment
11) they can be preserved and archived for decades, allowing for direct comparison of specimens
12) they bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain

Limitations

Biological monitoring is not intended to replace chemical sampling, toxicity testing, or fish surveys. Each of these measurements provides information not contained in the others. Similarly, assessments based on biological sampling should not be taken as being representative of chemical sampling. Some substances may be present in levels exceeding ambient water quality criteria, yet have no apparent adverse community impact.

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

multiplate: multiple-plate sampler, a type of artificial substrate sampler of aquatic macroinvertebrates

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 mostly 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: nonpoint nutrient additions, toxics, sewage effluent or animal wastes, municipal/industrial, siltation, impoundment, and natural. Cluster analysis was then performed within each group, using percent similarity, mostly at the family or genus level. Within each group different 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, the highest similarity of each source type is identified, and similarities that are within 5% of the highest. Similarities less than 50% are considered less conclusive. 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	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia	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
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
Psephenus	5	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	5	-	20	5	5	-	5	5	5	5	-	-	-
Promoresia	5	-	-	-	-	-	25	-	-	-	-	-	-
Stenelmis	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	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	5	-	-	10	-	-	5	-	-	5	5	5
Eukiefferiella/ Tvetenia	5	5	10	-	-	5	5	5	-	5	-	5	5
Parametriocnemus	-	-	-	-	-	-	-	5	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	20	-	-	10	20	20	5	-
Polypedilum (all others)	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									TOXIC				
	A	B	C	D	E	F	G	H	I	A	B	C	D	E
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-	5
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	-	10	20	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	5	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	10	10	-	20	10
GAMMARIDAE	-	-	-	5	-	-	-	-	-	5	-	-	-	5
Isonychia	-	-	-	-	-	-	-	5	-	-	-	-	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	15	10	20	-	-
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Caenis Tricorythodes	-	-	-	-	5	-	-	5	-	-	-		-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-	-	-	-	-
Optioservus	10	-	10	5	-	-	15	5	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	15	-	10	15	5	25	5	10	10	15	-	40	35
PHILOPOTAMIDAE	15	5	-	5	-	25	5	-	-	10	-	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	20	10	15	10	35
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-	20	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	-	-	-	-	-	5	-	-	5	10	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	15	10	25	10	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-	-	20	10	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	-	5	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	20	10	5	10	5	10	-	-	-	-
Tanytarsini	10	10	10	5	20	5	5	10	-	-	-	-	-	-
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	-	-
Isonychia	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE										
Tanypodinae	-	5	-	-	-	-	-	-	5	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	60
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

MUNICIPAL/INDUSTRIAL

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