New York State
Department of Environmental Conservation

Division of Water

Spring Run

Biological Assessment

2001 Survey

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BIOLOGICAL STREAM ASSESSMENT

Spring Run
Saratoga County, New York

Survey date: August 15, 2001
Report date: October 4, 2002

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Stream: Spring Run, Saratoga County, New York

Reach: Saratoga Springs, New York

Background:

The Stream Biomonitoring Unit conducted initial biological sampling on Spring Run on August 15, 2001. The purpose of the sampling was to assess general water quality, and determine the cause and spatial extent of any water quality problems. Traveling kick samples for macroinvertebrates were taken in riffle areas at 4 sites, using methods described in the Quality Assurance document (Bode et al., 2002) and summarized in Appendix 1. 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 NCO richness (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.

Supplemental macroinvertebrate sampling was performed on March 22, 2002, at Station 1 and upstream at Station 0, to measure possible sewage impacts. This was an effort to better measure effects of sewage inputs that entered the creek upstream of Station 1.

Results and Conclusions:

1. Based on macroinvertebrate sampling in August, 2001 and March, 2002, water quality in Spring Run ranged from slightly impacted to severely impacted. Severe impacts caused by sewage inputs were documented closest to the ·stream source.

2. Station 1 at Excelsior Spring Drive exhibited a more impacted fauna in March, 2002 than in August, 2001. The much higher conductivity levels measured in March support a genuine worsening of water quality over this time period.

Discussion

The upper 3 miles of Spring Run are listed on the Priority Water List, due to a fishing use impairment caused by occasional sewage overflows from Saratoga Springs (C) and possible inputs from the Saratoga (C) Landfill (NYS DEC, 2000). The present sampling was requested by NYS DEC Region 5 to document any spatial water quality trends along the length of the creek, especially in relation to sewage overflows.

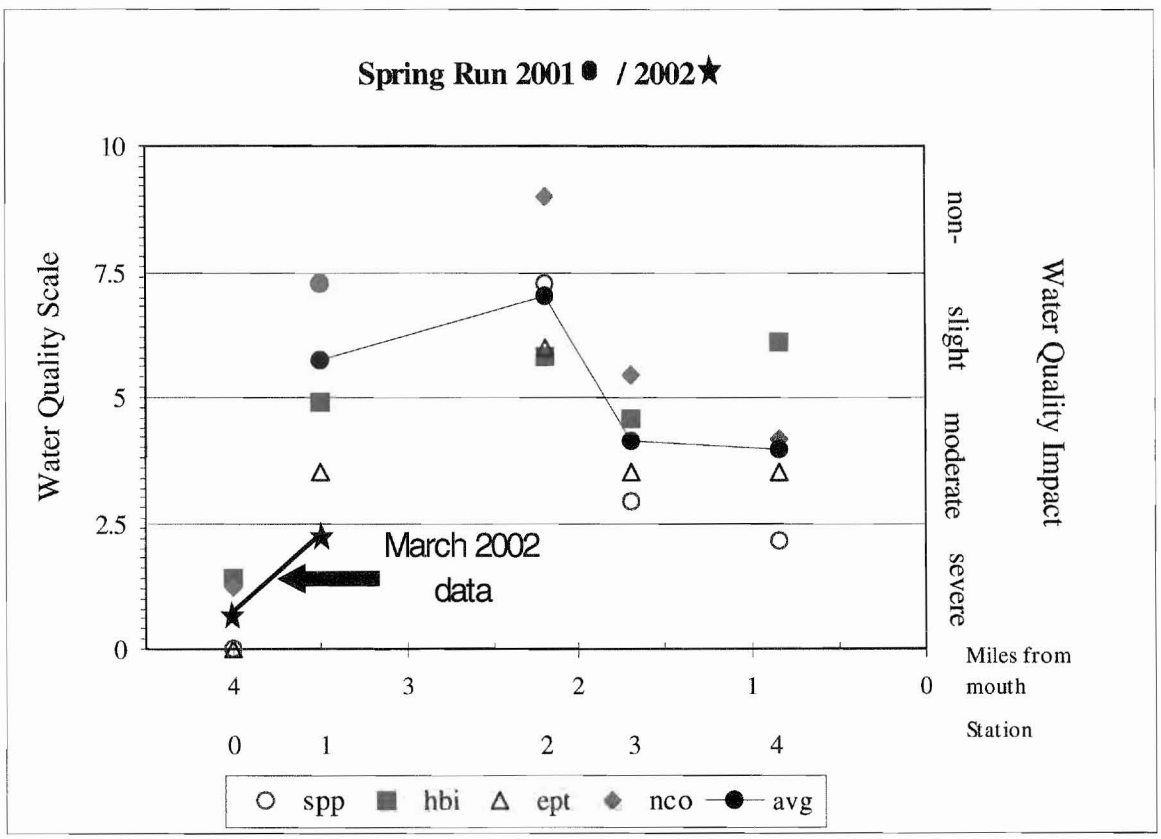
Based on the initial sampling in August, 2001, water quality in Spring Run was assessed as slightly impacted to moderately impacted (Figure 1). Because the habitats of Spring Run were dominated by gravel and sand rather than rubble, water quality assessments were obtained using sandy stream criteria (Bode et al., 2002). Following the initial sampling, it was learned that sewage inputs entered the stream upstream of Station 1.

To better measure possible sewage impacts, supplemental macroinvertebrate sampling was performed on March 22, 2002, at Station 1 and upstream at Station 0, 0.2 miles downstream of where the stream first appears above ground. Sewage had been observed in the stream, and was thought to enter via underground conduits (pers. comm., Terry Crannell, DEC Region 5). The March sampling documented severe water quality impacts, based on macroinvertebrate communities, at Stations 0 and 1. Impact Source Determination of these samples indicated municipal and/or industrial stressors. Macroinvertebrate communities at these sites were overwhelmingly dominated by sewage-tolerant worms and midges. Conductance at these sites and all downstream sites was high, and may also have exerted a limiting effect on the fauna (see Appendix XI).

Station 1 at Excelsior Spring Drive exhibited a more impacted fauna in March, 2002 than in August, 2001. Ongoing remediation work in the stream likely contributed high amounts of suspended and deposited fine sediments, although the fauna found at Station 1 in March clearly represented sewage impacts, rather than sediment impacts, as the primary factor of impairment. The much higher conductivity levels measured in March support a genuine worsening of water quality over this time period.

Impact Source Determination suggested municipal and/or industrial inputs at most sites (Table 1). The August, 2001 sample at Station 1 indicated a more toxic impact, for unknown reasons. Also unexplained is the sharp drop in water quality at the Gilbert Road site (Station 3) compared to the Weibel Road site (Station 2). The designation of possible impoundment effects at Stations 2-4 is likely a result of sluggish currents at these sites. The macroinvertebrate communities at these three sites were dominated by scuds, crustaceans that prefer areas of macrophytes and slower currents.

Figure 1. Biological Assessment Profile of index values, Spring Run, 2001. 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 NCO richness. See Appendix IV for more complete explanation.



Literature Cited:

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

New York State Department of Environmental Conservation. 2000. Priority Waterbodies List for the Upper Hudson River Basin. New York State Department of Environmental Conservation, Technical Report.

Overview of field data

On the initial sampling date, August 15, 2001, Spring Run at the sites sampled was 5-6 meters wide, 0.2-0.3 meters deep, and had current speeds of 35-63 cm/sec in riffles. Dissolved oxygen was 9.0-9.5 mg/l, specific conductance was 1269-1510 μmhos, pH was 7.7-8.0, and the temperature was 17.3-20.1 °C (63-68 °F). Measurements for each site from both sampling dates are found on the field data summary sheets.

Table 1. Impact Source Determination, Flint and Nettle Valley Creeks, 2002. Numbers represent similarity to community type models for each impact category. The highest similarities at each station within approximately 5% are highlighted. Similarities less than 50% are less conclusive.

	STATION							
Community Type	1	2	3	4	5	6	7	A
Natural: minimal human impacts	58	40	32	31	31	33	36	39
Nutrient additions: mostly nonpoint, agricultural	55	37	47	51	51	51	48	43
Toxic: industrial, municipal, or urban run-off	45	28	58	64	65	60	55	39
Organic: sewage effluent, animal waste	24	23	43	64	66	58	45	33
Complex: municipal/industrial	26	19	44	59	68	51	53	31
Siltation	44	31	46	58	57	72	62	42
Impoundment	40	30	64	60	62	50	49	41

TABLE

STATION	COMMUNITY TYPE
1	Natural/ Non – point source
2	Natural/ Non – point source
3	Impoundment
4	Toxic/ Organic/ Complex/ Impoundment
5	Toxic/ Organic/ Complex
6	Siltation
7	Siltation
A	Natural/ Non – point source/ Siltation

TABLE 2. STATION LOCATIONS FOR SPRING RUN, SARATOGA COUNTY, NEW YORK (see map).

STATION	LOCATION
00	Saratoga Springs Excelsior Ave. @ East Ave. 4.0 miles above mouth Latitude/longitude: 43°05'21”;73°46’17”
01	Saratoga Springs 5 meters above Excelsior Springs Dr. bridge 3.5 miles above mouth Latitude/longitude: 43°05'20”;73°45’49”
02	Saratoga Springs 10 meters above Weibel Ave bridge 2.2 miles above mouth Latitude/longitude: 43°05'08”;73°44’40”
03	Saratoga Springs 5 meters below Gilbert Rd bridge 1.7 miles above mouth Latitude/longitude: 43°04'51”;73°44’29”
04	Saratoga Springs 5 meters below Union Ave. bridge 0.8 miles above mouth Latitude/longitude: 43°04'11”;73°44’41”

Figure 2	Site Location Map	Spring Run

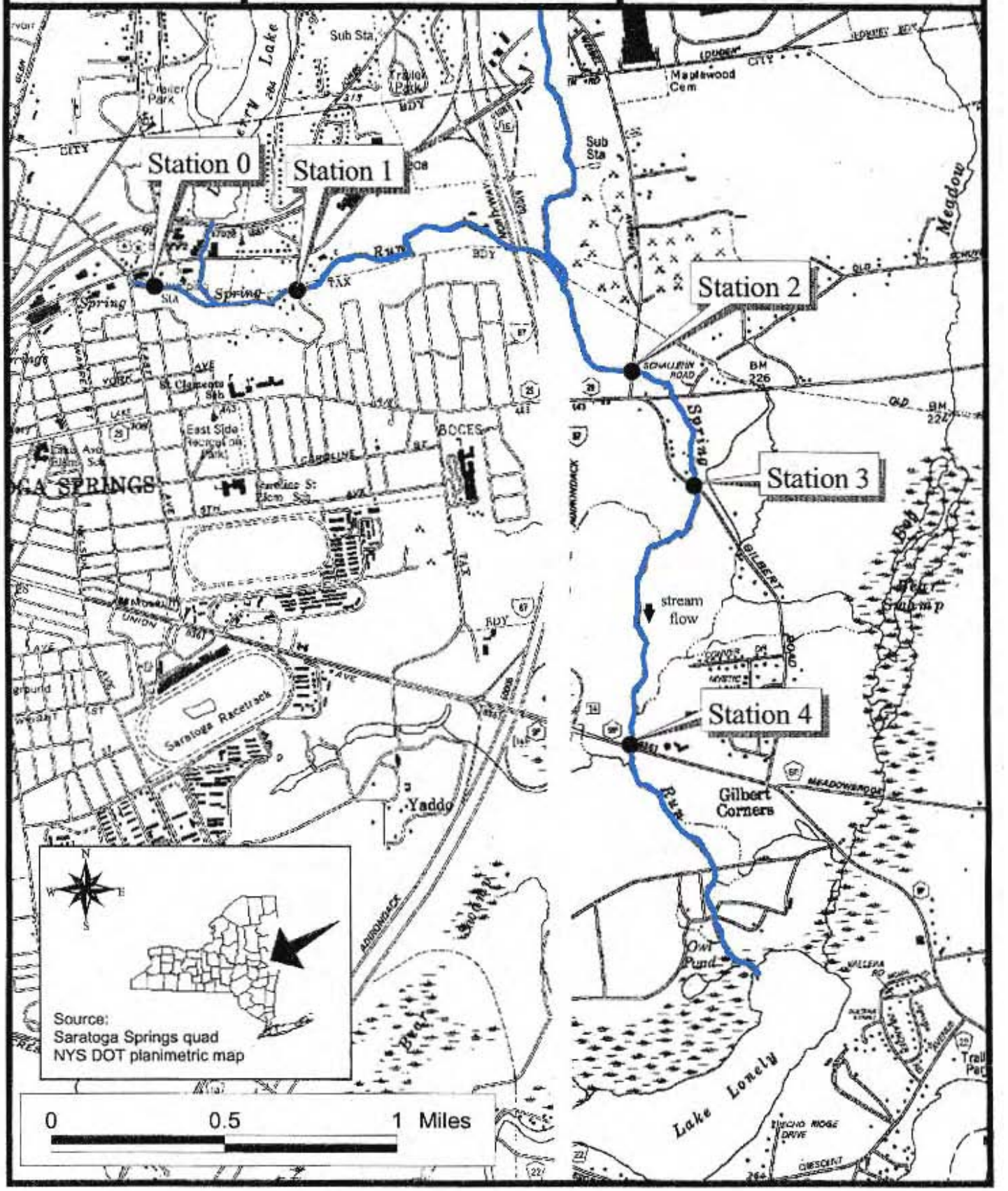


TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN SPRING RUN, SARATOGA COUNTY, NEW YORK, 2001-2002.

PLATYHELMINTHES
- TURBELLARIA
  - Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - Enchytraeidae
    - Undetermined Enchytraeidae
  - Tubificidae
    - Limnodrilus hoffmeisteri
    - Undet. Tubificidae w/ cap. setae
  - Naididae
    - Nais elinguis
    - Ophidonais serpentina

HIRUDINEA
- Undetermined Hirudinea

MOLLUSCA
- GASTROPODA
  - Physidae
    - Physella sp.
- PELECYPODA
  - Sphaeriidae
    - Pisidium sp.

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea racovitzai
      - Caecidotea sp.
  - AMPHIPODA
    - Gammaridae
      - Gammarus sp.
- INSECTA
  - EPHEMEROPTERA
    - Baetidae
      - Callibaetis sp.
  - ODONATA
    - Aeschnidae
      - Undetermined Aeschnidae
    - Coenagrionidae
      - Undetermined Coenagrionidae
  - HEMIPTERA
    - Corixidae
      - Undetermined Corixidae
  - COLEOPTERA
    - Dytiscidae
      - Agabus sp.
      - Undetermined Dytiscidae
    - Elmidae
      - Optioservus fastiditus
  - TRICHOPTERA
    - Hydropsychidae
      - Cheumatopsyche sp.
      - Hydropsyche betteni
      - Hydropsyche sp.
    - Leptoceridae
      - Undetermined Leptoceridae
  - DIPTERA
    - Tipulidae
      - Dicranota sp.
      - Tipula sp.
    - Ceratopogonidae
      - Undetermined Ceratopogonidae
    - Simuliidae
      - Simulium vittatum
    - Muscidae
      - Undetermined Muscidae
    - Chironomidae
      - Tanypodinae
        - Thienemannimyia gr. spp.
      - Diamesinae
        - Pagastia sp. A
      - Prodiamesinae
        - Odontomesa sp.
        - Prodiamesa olivacea
      - Orthocladiinae
        - Brillia sp.
        - Cricotopus bicinctus
        - Cricotopus tremulus
        - Cricotopus vierriensis
        - Thienemanniella xena?
      - Chironominae
        - Chironomini
          - Chironomus sp.
          - Cladopelma sp.
          - Cryptochironomus fulvus gr.
          - Microtendipes pedellus gr.
          - Polypedilum flavum
          - Polypedilum scalaenum gr.
          - Saetheria tylus
          - Stictochironomus sp.
        - Tanytarsini
          - Micropsectra polita
          - Paratanytarsus confusus
          - Rheotanytarsus exiguus gr.

STREAM SITE:	Spring Run, Station 0
LOCATION:	Saratoga Springs, New York, Excelsior Avenue below East Avenue
DATE:	22 March 2002
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA			
OLIGOCHAETA	Enchytraeidae	Undetermined Enchytraeidae	53
	Tubificidae	Limnodrilus hoffmeisteri	4
	Naididae	Nais elinguis	3
ARTHROPODA			
INSECTA			
DIPTERA	Tipulidae	Tipula sp.	1
	Chironomidae	Prodiamesa olivacea	37
		Cricotopus tremulus	2

SPECIES RICHNESS	6 (very poor)
BIOTIC INDEX	8.79 (very poor)
EPT RICHNESS	0 (very poor)
NCO RICHNESS*	1 (very poor)
ASSESSMENT	severely impacted

DESCRIPTION The sample was taken off Excelsior Avenue, approximately 300 meters downstream of East Avenue. The substrate was primarily sand and gravel. The macroinvertebrate fauna was heavily dominated by midges and worms. Based on the metric values, using criteria for slow sandy streams, water quality was assessed as severely impacted.

* NCO richness denotes the total number of species of organisms other than those in the groups Chironomidae and Oligochaeta. Since Chironomidae and Oligochaeta are generally the most abundant groups in impacted communities, NCO taxa are considered to be less pollution tolerant, and their presence would be expected to be more indicative of good water quality. See Appendix II.

STREAM SITE: Spring Run, Station 1
LOCATION: Saratoga Springs, New York, above Excelsior Springs Dr.
DATE: 22 March 2002
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

PLATYHELMINTHES	Turbellaria	Undetermined Turbellaria	1
	Enchytraeidae	Undetermined Enchytraeidae	1
ANNELIDA	Tubificidae	Limnodrilus hoffmeisteri	21
OLIGOCHAETA		Undet. Tubificidae w/ cap. setae	2
		Nais elinguis	35
		Ophidonais serpentina	5
HIRUDINEA		Undetermined Hirudinea	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Pisidium sp.	1
ARTHROPODA			
INSECTA			
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	4
		Prodiamesa olivacea	1
		Cricotopus bicinctus	21
		Cricotopus tremulus	7

SPECIES RICHNESS 12 (poor)
BIOTIC INDEX 9.16 (very poor)
EPT RICHNESS 0 (very poor)
NCO RICHNESS 3 (poor)
ASSESSMENT severely impacted

DESCRIPTION The sample was taken 5 meters upstream of Excelsior Springs Drive. The macroinvertebrate fauna was heavily dominated by midges and worms. Based on the metric values, using criteria for slow sandy streams, water quality was assessed as severely impacted.

STREAM SITE: Spring Run, Station 1
LOCATION: Saratoga Springs, New York, above Excelsior Springs Dr.
DATE: 15 August 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

ANNELIDA			
OLIGOCHAETA	Enchytraeidae	Undetermined Enchytraeidae	2
	Tubificidae	Limnodrilus hoffmeisteri	4
		Undet. Tubificidae w/ cap. setae	19
HIRUDINEA		Undetermined Hirudinea	4
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	5
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp.	3
INSECTA			
EPHEMEROPTERA	Baetidae	Callibaetis sp.	1
COLEOPTERA	Dytiscidae	Agabus sp.	2
		Undetermined Dytiscidae	1
	Elmidae	Optioservus fastiditus	1
TRICHOPTERA	Hydropsychidae	Hydropsyche sp.	1
DIPTERA	Simuliidae	Simulium vittatum	2
	Muscidae	Undetermined Muscidae	2
	Chironomidae	Thienemannimyia gr. spp.	37
		Odontomesa sp.	1
		Prodiamesa olivacea	6
		Brillia sp.	1
		Cricotopus bicinctus	2
		Cricotopus vierriensis	1
		Chironomus sp.	1
		Micropsectra polita	4

SPECIES RICHNESS 21 (good)
BIOTIC INDEX 7.06 (poor)
EPT RICHNESS 2 (poor)
NCO RICHNESS 10 (good)
ASSESSMENT slightly impacted

DESCRIPTION The sample was taken 5 meters upstream of Excelsior Springs Drive. The stream was slow-moving, silty, and with much refuse in the stream and along the banks. The macroinvertebrate fauna was heavily dominated by midges and worms. Based on the metric values, using criteria for slow sandy streams, water quality was assessed as slightly impacted.

STREAM SITE: Spring Run, Station 2
LOCATION: Saratoga Springs, New York, above Weibel Ave.
DATE: 15 August 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

ANNELIDA			
OLIGOCHAETA	Enchytraeidae	Undetermined Enchytraeidae	5
	Tubificidae	Limnodrilus hoffmeisteri	11
		Undet. Tubificidae w/ cap. setae	1
HIRUDINEA		Undetermined Hirudinea	1
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp.	6
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
EPHEMEROPTERA	Baetidae	Callibaetis sp.	1
ODONATA	Coenagrionidae	Undetermined Coenagrionidae	1
	Corixidae	Undetermined Corixidae	5
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	2
		Hydropsyche betteni	11
DIPTERA	Leptoceridae	Undetermined Leptoceridae	1
	Tipulidae	Dicranota sp.	2
	Ceratopogonidae	Undetermined Ceratopogonidae	1
	Simuliidae	Simulium vittatum	1
	Chironomidae	Pagastia sp. A	1
		Prodiamesa olivacea	6
		Thienemanniella xena?	1
		Cladopelma sp.	1
		Saetheria tylus	1

SPECIES RICHNESS 21 (good)
BIOTIC INDEX 6.50 (good)
EPT RICHNESS 4 (good)
NCO RICHNESS 13 (very good)
ASSESSMENT slightly impacted

DESCRIPTION The stream bottom at this site was predominantly sand and silt, with very little rubble or gravel. The sample was dominated by scuds and worms, likely reflecting the poor substrate. Based on the metric values, water quality was assessed as slightly impacted.

STREAM SITE: Spring Run, Station 3
LOCATION: Saratoga Springs, New York, below Gilbert Rd.
DATE: 15 August 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Limnodrilus hoffmeisteri	5
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	13
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
ODONATA	Aeschnidae	Undetermined Aeschnidae	1
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	1
		Hydropsyche betteni	4
DIPTERA	Simuliidae	Simulium vittatum	4
	Chironomidae	Thienemannimyia gr. spp.	2
		Cryptochironomus fulvus	1
		Polypedilum flavum	1
		Stictochironomus sp.	25
		Rheotanytarsus exiguus	3

SPECIES RICHNESS 12 (poor)
BIOTIC INDEX 7.25 (poor)
EPT RICHNESS 2 (poor)
NCO RICHNESS 6 (good)
ASSESSMENT moderately impacted

DESCRIPTION The stream bottom at this site was almost entirely sand, with small amounts of silt and gravel. The macroinvertebrate fauna was very limited, dominated by scuds and tolerant midges, reflecting the poor substrate and possibly poorer water quality. Water quality was assessed as moderately impacted.

STREAM SITE: Spring Run, Station 4
LOCATION: Saratoga Springs, New York, below Union St.
DATE: 15 August 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

ANNELIDA			
OLIGOCHAETA	Tubificidae	Limnodrilus hoffmeisteri	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	15
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	7
		Hydropsyche betteni	1
DIPTERA	Chironomidae	Cryptochironomus fulvus	3
		Microtendipes pedellus	3
		Polypedilum flavum	20
		Polypedilum scalaenum gr.	3
		Paratanytarsus confusus	3
		Rheotanytarsus exiguus	4

SPECIES RICHNESS 11 (very poor)
BIOTIC INDEX 6.33 (good)
EPT RICHNESS 2 (poor)
NCO RICHNESS 4 (poor)
ASSESSMENT moderately impacted

DESCRIPTION The sampling site was 5 meters downstream of Union Street, Saratoga Springs. The habitat sampled was primarily gravel beds between beds of the aquatic plant, Elodea. The limited macroinvertebrate fauna consisted mostly of scuds and midges. Based on the metrics, water quality was assessed as moderately impacted.

LABORATORY DATA SUMMARY				
STREAM NAME: Spring Run		**DRAINAGE: 11**		
DATE SAMPLED: 08/15/01		**COUNTY: Saratoga**		
SAMPLING METHOD: Traveling kick				
STATION	01	02	03	04
LOCATION	Excelsior Spr. Rd.	Weibel Ave.	Gilbert Rd.	Union Ave.
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Thienemannimyia gr. spp.	Gammarus sp.	Gammarus sp.	Gammarus sp.
	37 %	40 %	40 %	40 %
	facultative	facultative	facultative	facultative
	midge	scud	scud	scud
2.	Limnodrilus hoffmeisteri	Limnodrilus hoffmeisteri	Stictochironomus sp.	Polypedilum flavum
Intolerant = not tolerant of poor	19 %	11 %	25 %	20 %
water quality	tolerant	tolerant	tolerant	facultative
	worm	worm	midge	midge
3.	Prodiamesa olivacea	Hydropsyche betteni	Caecidotea racovitzai	Caecidotea racovitzai
Facultative = occurring over a	6 %	11 %	13 %	15 %
wide range of water quality	intolerant	facultative	tolerant	tolerant
	midge	caddisfly	sowbug	sowbug
4.	Physella sp.	Caecidotea racovitzai	Limnodrilus hoffmeisteri	Cheumatopsyche sp.
Tolerant = tolerant of poor	5 %	6 %	5 %	7 %
water quality	tolerant	tolerant	tolerant	facultative
	snail	sowbug	worm	caddisfly
5.	Undet. Tubific. w/ cap. setae	Prodiamesa olivacea	Hydropsyche betteni	Rheotanytarsus exiguus gr.
	4 %	6 %	4 %	4 %
	tolerant	intolerant	facultative	facultative
	worm	midge	caddisfly	midge
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	53.0 (8.0)	10.0 (5.0)	32.0 (5.0)	36.0 (6.0)
Trichoptera (caddisflies)	1.0 (1.0)	14.0 (3.0)	5.0 (2.0)	8.0 (2.0)
Ephemeroptera (mayflies)	1.0 (1.0)	1.0 (1.0)	0.0 (0.0)	0.0 (0.0)
Plecoptera (stoneflies)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Coleoptera (beetles)	4.0 (3.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Oligochaeta (worms)	25.0 (3.0)	17.0 (3.0)	5.0 (1.0)	1.0 (1.0)
Other	16.0 (5.0)	58.0 (9.0)	58.0 (4.0)	55.0 (2.0)
SPECIES RICHNESS	21	21	12	11
BIOTIC INDEX	7.06	6.5	7.25	6.33
EPT RICHNESS	2	4	2	2
NCO RICHNESS	10	13	6	4
FIELD ASSESSMENT	poor	poor	poor	poor
OVERALL ASSESSMENT	slightly impacted	slightly impacted	moderately impacted	moderately impacted

LABORATORY DATA SUMMARY				
STREAM NAME: Spring Run		**DRAINAGE: 11**		
DATE SAMPLED: 03/22/02		**COUNTY: Saratoga**		
SAMPLING METHOD: Net sample; sandy streams criteria				
STATION **LOCATION**	00 Saratoga Springs	01 Saratoga Springs		
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Undetermined Enchytraeidae 53 % tolerant worm	Nais elinguis 35 % tolerant worm		
2. **Intolerant = not tolerant of poor water quality**	Prodiamesa olivacea 37 % tolerant midge	Limnodrilus hoffmeisteri 21 % tolerant worm		
3. **Facultative = occurring over a wide range of water quality**	Limnodrilus hoffmeisteri 4 % tolerant worm	Cricotopus bicinctus 21 % tolerant midge		
4. **Tolerant = tolerant of poor water quality**	Nais elinguis 3 % tolerant worm	Cricotopus tremulus gr. 7 % facultative midge		
5.	Cricotopus tremulus gr. 2 % facultative midge	Ophidonais serpentina 5 % facultative worm		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	39 (2)	33 (4)		
Trichoptera (caddisflies)	0 (0)	0 (0)		
Ephemeroptera (mayflies)	0 (0)	0 (0)		
Plecoptera (stoneflies)	0 (0)	0.(0)		
Coleoptera (beetles)	0 (0)	0 (0)		
Oligochaeta (worms)	60 (3)	64 (5)		
Mollusca (clams and snails)	0 (0)	1 (1)		
Crustacea (crayfish, scuds, sowbugs)	0 (0)	0 (0)		
Other insects (odonates, diptera)	1 (1)	0 (0)		
Other (Nemertea, Platyhelminthes)	0 (0)	2 (2)		
SPECIES RICHNESS **BIOTIC INDEX** **EPT RICHNESS** **PERCENT MODEL AFFINITY**	6 9.16 0 26	12 8.68 0 28		
FIELD ASSESSMENT **OVERALL ASSESSMENT**	 severe	 severe		

FIELD DATA SUMMARY

STREAM NAME: Spring Run **DATE SAMPLED: 08/15/01**
REACH: Excelsior to Union St; Saratoga
FIELD PERSONNEL INVOLVED:Bode, Novak

STATION	01	02	03	04
ARRIVAL TIME AT STATION	10:30	11:00	11:40	12:15
LOCATION	Excelsior Spr Dr.	Weibel Ave.	Gilbert Rd.	Union Ave..
PHYSICAL CHARACTERISTICS				
Width (meters)	5	5	5	6
Depth (meters)	0.2	0.2	0.3	0.3
Current speed (cm per sec.)	40	63	35	50
Substrate (%)				
Rock (>25.4 cm, or bedrock)	0	0	0	0
Rubble (6.35 - 25.4 cm)	30	20	0	10
Gravel (0.2 – 6.35 cm)	20	20	30	30
Sand (0.06 – 2.0 mm)	20	40	50	30
Silt (0.004 – 0.06 mm)	30	20	20	30
Embeddedness (%)	50	50	40	40
CHEMICAL MEASUREMENTS				
Temperature (°C)	17.3	18.1	18.3	20.1
Specific Conductance (umhos)	1269	1489	1510	1382
Dissolved Oxygen (mg/l)	9.0	9.0	9.4	9.5
pH	7.8	8.0	7.9	7.7
BIOLOGICAL ATTRIBUTES				
Canopy (%)	20	40	10	10
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous				
algae - diatoms				
macrophytes or moss	present		present	present
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X			
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X		X
Coleoptera (beetles)	X	X		
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X	X	X
Simuliidae (black flies)	X			
Decapoda (crayfish)	X	X	X	X
Gammaridae (scuds)		X	X	X
Mollusca (snails, clams)				
Oligochaeta (worms)	X			X
Other	X	X		X
FIELD ASSESSMENT	poor	poor	poor	poor

FIELD DATA SUMMARY

STREAM NAME: Spring Run **DATE SAMPLED: 03/22/02**
REACH: Saratoga Springs
FIELD PERSONNEL INVOLVED:Bode, Smith

STATION	00	01		
ARRIVAL TIME AT STATION	9:30	10:05		
LOCATION	East Ave.	Spring Ave.		
PHYSICAL CHARACTERISTICS				
Width (meters)	5	5		
Depth (meters)	0.1	0.2		
Current speed (cm per sec.)	50	30		
Substrate (%)				
Rock (>25.4 cm, or bedrock)	-	-		
Rubble (6.35 - 25.4 cm)	10	20		
Gravel (0.2 – 6.35 cm)	30	20		
Sand (0.06 – 2.0 mm)	50	30		
Silt (0.004 – 0.06 mm)	10	30		
Embeddedness (%)	20	30		
CHEMICAL MEASUREMENTS				
Temperature (° C)	7.0	6.5		
Specific Conductance (umhos)	2455	2286		
Dissolved Oxygen (mg/l)	11.5	10.4		
pH	7.2	7.4		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	50	20		
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous				
algae - diatoms				
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)				
Plecoptera (stoneflies)				
Trichoptera (caddisflies)				
Coleoptera (beetles)				
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X		
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X	X		
FIELD ASSESSMENT	moderate	-		

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 five minutes for a distance of five 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 stereo microscope 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). If the results of the identification process are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

MACROINVERTEBRATE COMMUNITY PARAMETERS

1. Species richness is the total number of species or taxa found in the sample. For subsamples of 100-organisms each that are taken from kick samples, expected ranges in most New York State streams are: greater than 26, non-impacted; 19-26, slightly impacted; 11 - 18, moderately impacted; less than 11, severely impacted.

2. EPT Richness 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. Hilsnhoff 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; 4.5 1-6.50, slightly impacted; 6.5 1-8.50, 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 seven major macroinvertebrate groups (Novak and Bode, 1992). Percent abundances in the model community are 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Impact ranges are: greater than 64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and less than 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. NY S 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.

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 richness, biotic index, and percent model affinity (*see Macroinvertebrate Community Parameters Appendix*). The consensus is based on the determination of the majority of the parameters. Since parameters measure different aspects of the macroinvertebrate community, they cannot be expected to always form unanimous assessments. The assessment ranges given for each parameter are based on subsamples of 100-organism each that are taken from macroinvertebrate riffle kick samples. These assessments 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; EPT richness 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.

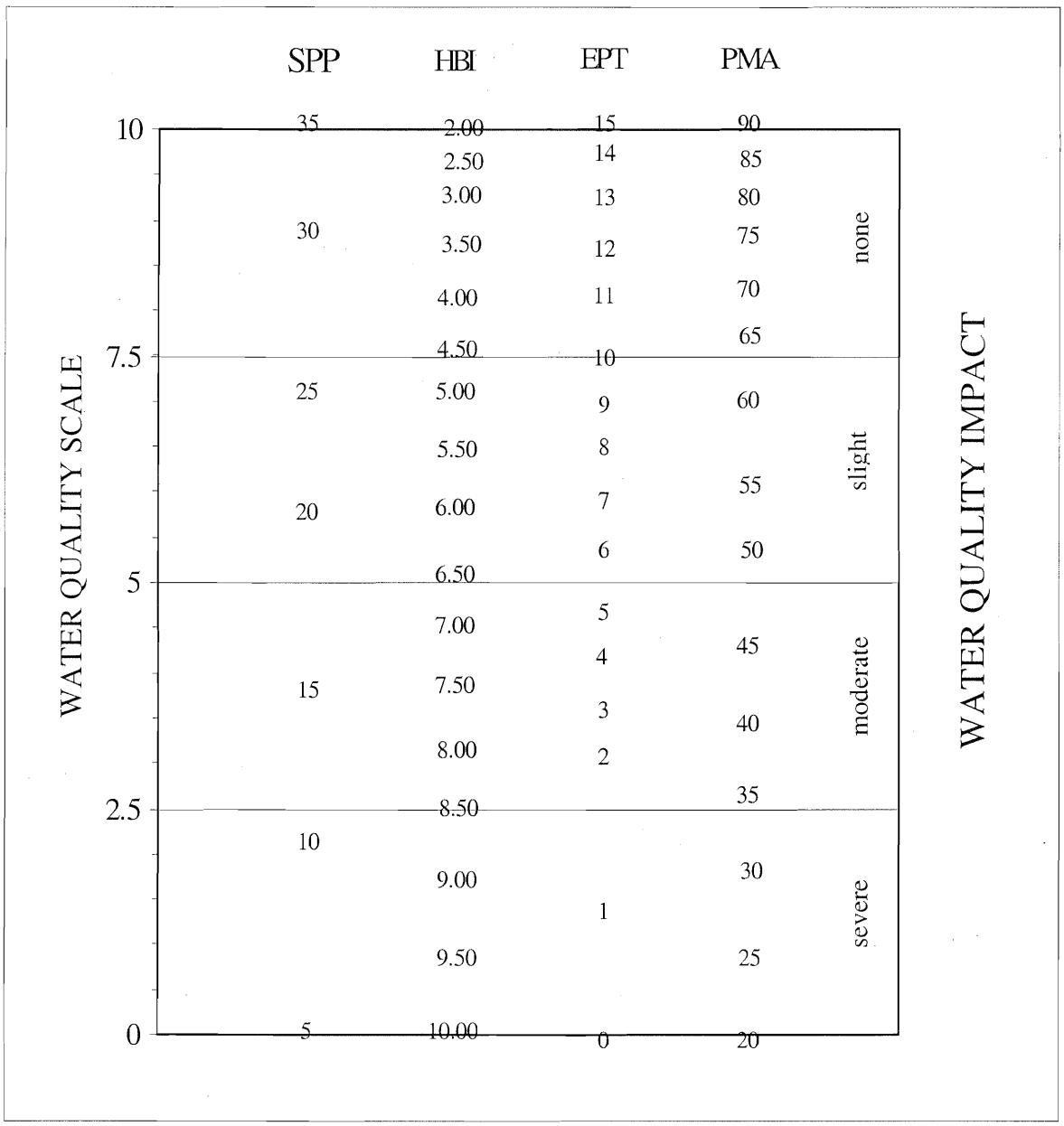
2. *Slightly impacted* Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. 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 richness 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 richness 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.

Biological Assessment Profile: Conversion of Index values to Common 10-Scale

The Biological Assessment Profile of index values, developed by Phil O'Brien, Division of Water, NYSDEC, is a method of plotting biological index values on a common scale of water-quality impact. Values from the four indices, defined in the Macroinvertebrate Community Parameter Appendix, are converted to a common 0-10 scale using the formulae in the Quality Assurance document (Bode, et al., 2002) and as shown in the figure below.



Biological Assessment Profile: Plotting Values

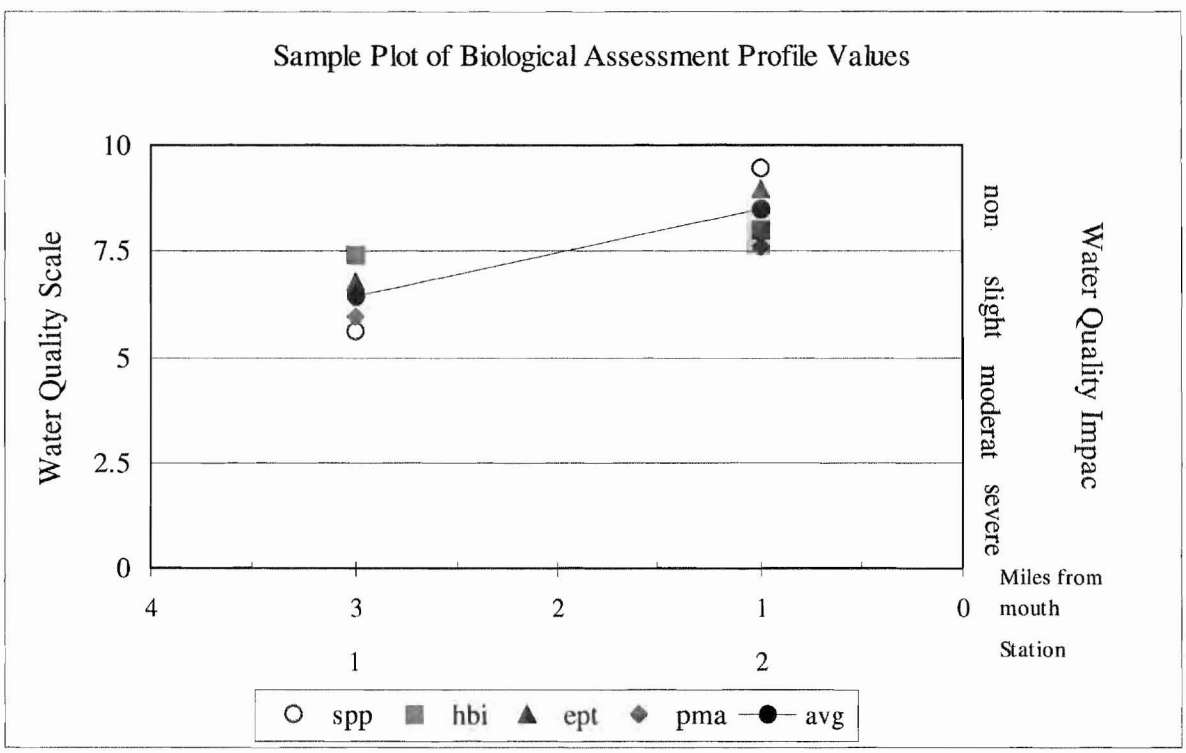
To plot survey data:

1. Position each site on the x-axis according to miles or tenths of a mile upstream of the mouth.
2. Plot the values of the four indices for each site as indicated by the common scale.
3. Calculate the mean of the four values and plot the result. This represents the assessed impact for each site.

Example data:

	Station 1		Station 2	
	metric value	10-scale value	metric value	10-scale value
Species richness	20	5.59	33	9.44
Hilsenhoff biotic index	5.00	7.40	4.00	8.00
EPT richness	9	6.80	13	9.00
Percent model affinity	55	5.97	65	7.60
Average		6.44 (slight)		8.51 (non-)

Table IV-B. Sample Plot of Biological Assessment Profile values



Water Quality Assessment Criteria

Water Quality Assessment Criteria for Non-Navigable Flowing Waters

	Species Richness	Hilsenhoff Biotic Index	EPT Richness	Percent Model Affinity#	Species 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 Richness	Species 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.

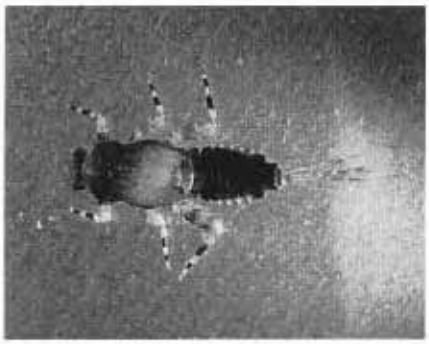
THE TRAVELING KICK SAMPLE

← 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.

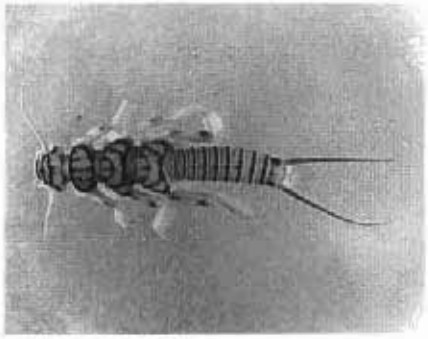
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

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.



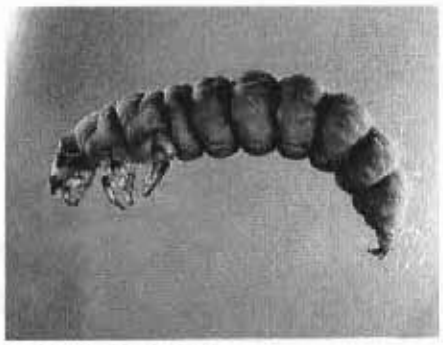
MAYFLIES

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.



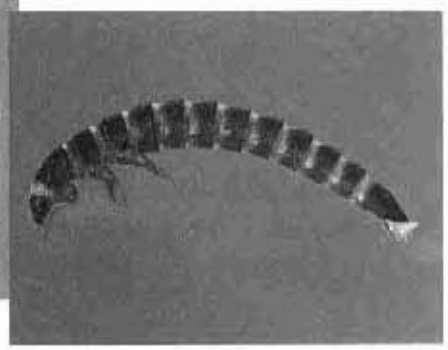
STONEFLIES

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 nutrient-enriched stream segments.



CADDISFLIES

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.



BEETLES

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

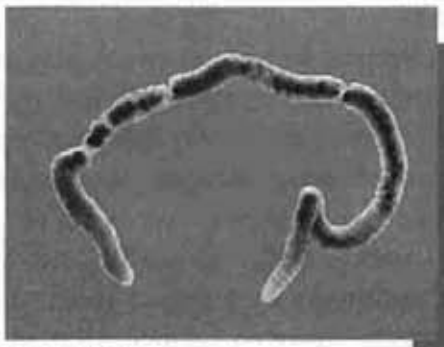
Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called "bloodworms" indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.

MIDGES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

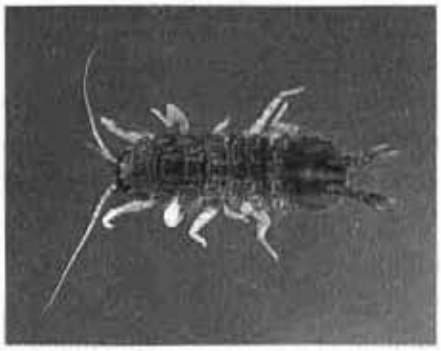
BLACK FLIES

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.



WORMS

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. They are classic indicators of sewage pollution, and can also thrive in toxic situations.



SOWBUGS

Digital images by Larry Abele, New York State Department of Environmental Conservation, Stream Biomonitoring Unit.

THE RATIONALE OF BIOLOGICAL MONITORING

Biological monitoring 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, e.g. 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 ail 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.

Anthropogenic: caused by human actions

Assessment: a diagnosis or evaluation of water quality

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

Bioaccumulate: accumulate contaminants in the tissues of an organism

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 richness: the number of species of mayflies (**E**phemeroptera), stoneflies (**P**lecoptera), and caddisflies (**Tr**ichoptera) in a sample or subsample

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

Longitudinal trends: upstream-downstream changes in water quality in a river or stream

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

PAHs: Polycyclic Aromatic Hydrocarbons, a class of organic compounds that are often toxic or carcinogenic

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

Riffle: wadeable stretch of stream usually having a rubble bottom and sufficient current to break the water surface; 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

Synergistic effect: an effect produced by the combination of two factors that is greater than the sum of the two factors

Tolerant: able to survive poor water quality

Impact Source Determination Methods and Community Models

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. ISD 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 was 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 ISD (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 percent, 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 subsamples of 100-organisms each that are taken from traveling kick samples of New York State streams. Application of these methods for data derived from other sampling methods, habitats, or geographical areas would likely require modification of the models.

Impact Source Determination 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

Impact Source Determination Models

NONPOINT NUTRIENTS, PESTICIDES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	5	-	-	-	-	-	-
Isonychia	-	-	-	-	-	-	-	5	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	5
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-
Caenis/Tricorythodes	-	-	-	-	5	-	-	5	-	5
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-
Optioservus	10	-	-	5	-	-	15	5	-	5
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	-	5
CHIRONOMIDAE										
Tanypodinae	-	-	-	-	-	-	5	-	-	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Microtendipes	-	-	-	-	-	-	-	-	-	20
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

	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
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	10	20	-	5	10	5	5	15	10	25	10	5	10
Eukiefferiella/ Tvetenia	-	-	-	-	-	-	-	-	-	-	20	10	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (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

Impact Source Determination Models

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

Impact Source Determination Models

	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

BIOLOGICAL IMPACTS OF WATERS WITH HIGH CONDUCTIVITY

Definition Conductivity is a measure of the ability of an aqueous solution to carry an electric current. It may be used to estimate salinity, total dissolved solids (TDS), and chlorides. Salinity is the amount of dissolved salts in a given amount of solution. Total dissolved solids, although not precisely equivalent to salinity, is closely related, and for most purposes can be considered synonymous. EPA has not established ambient water-quality criteria for salinity; for drinking water, maximum contaminant levels are 250 mg/L for chlorides, and 500 mg1L for dissolved solids (EPA, 1995).

Measurement Conductivity is measured as resistance, and is reported in micromhos per centimeter (μmhos/cm), which is equivalent to microsiemens per centimeter (μS/cm). TDS and salinity can be estimated from conductivity by multiplying by 0.64, and expressed in parts per million; for marine waters, salinity is usually expressed in parts per thousand. Chlorides can be estimated from conductivity measurements by multiplying by 0.2 1, and expressed in parts per million. Departures from these estimates can occur when elevated conductivity is a result of natural conditions, such as in situations of high alkalinity (bicarbonates), or sulfates.

Effects on macroinvertebrates Bioassays on test animals found the toxicity threshold for Daphnia *magna* to be 6- 10 parts per thousand salinity (6000- 10,000 mg/L) (Ingersoll et al., 1992). Levels of concern for this species were set at 0.3-6 parts per thousand salinity (300-6000 mg/L) (U.S. Dept. of Interior, 1998).

Stream Biomonitoring findings Of 26 New York State streams sampled with conductivity levels exceeding 1200 μmhos/cm, 69% were assessed as moderately impacted, 8% were assessed as severely impacted, and 23% were assessed as slightly impacted. Many of the benthic communities in the impacted streams were dominated by oligochaetes, midges, and crustaceans (scuds and sowbugs). 35% of the streams were considered to derive their high conductivity primarily from natural sources, while the remainder were the result of contributions from point and nonpoint anthropogenic sources. For nearly all streams with high conductivity, other contaminants are contained in the water column, making it difficult to isolate effects of high conductivity.

Recommendations Conductivity may be best used as an indicator of elevated amounts of anthropogenic-source contaminants. Based on findings that the median impact at sites with conductivity levels exceeding 1200 μmhos/cm is moderate impact, this amount is designated as a level of concern, with expected biological impairments. This level corresponds to ~250 mg/L chlorides, ~750 parts per million Total Dissolved Solids, and ~0.75 parts per thousand salinity.

U.S. Dept. of Interior. 1998. Guidelines for interpretation of the biological effects of selected constituents in biota, water, and sediment. Nat. Irrigat. Water Qual. Prog. Inform. Rep. 3.

Ingersoll, C.G., F.J. Dwyer, S.A. Burch, M.K. Nelson, D.R. Buckler, and J.B. Hum. The use of freshwater and saltwater animals to distinguish between the toxic effects of salinity and contaminants in irrigation drain water. Env. Tox. Chem. 11:503-511.

U.S. EPA. 1995. Drinking water regulations and health advisories. U. S. Environmental Protection Agency, Office of Water, Washington, D.C. 11 pages.