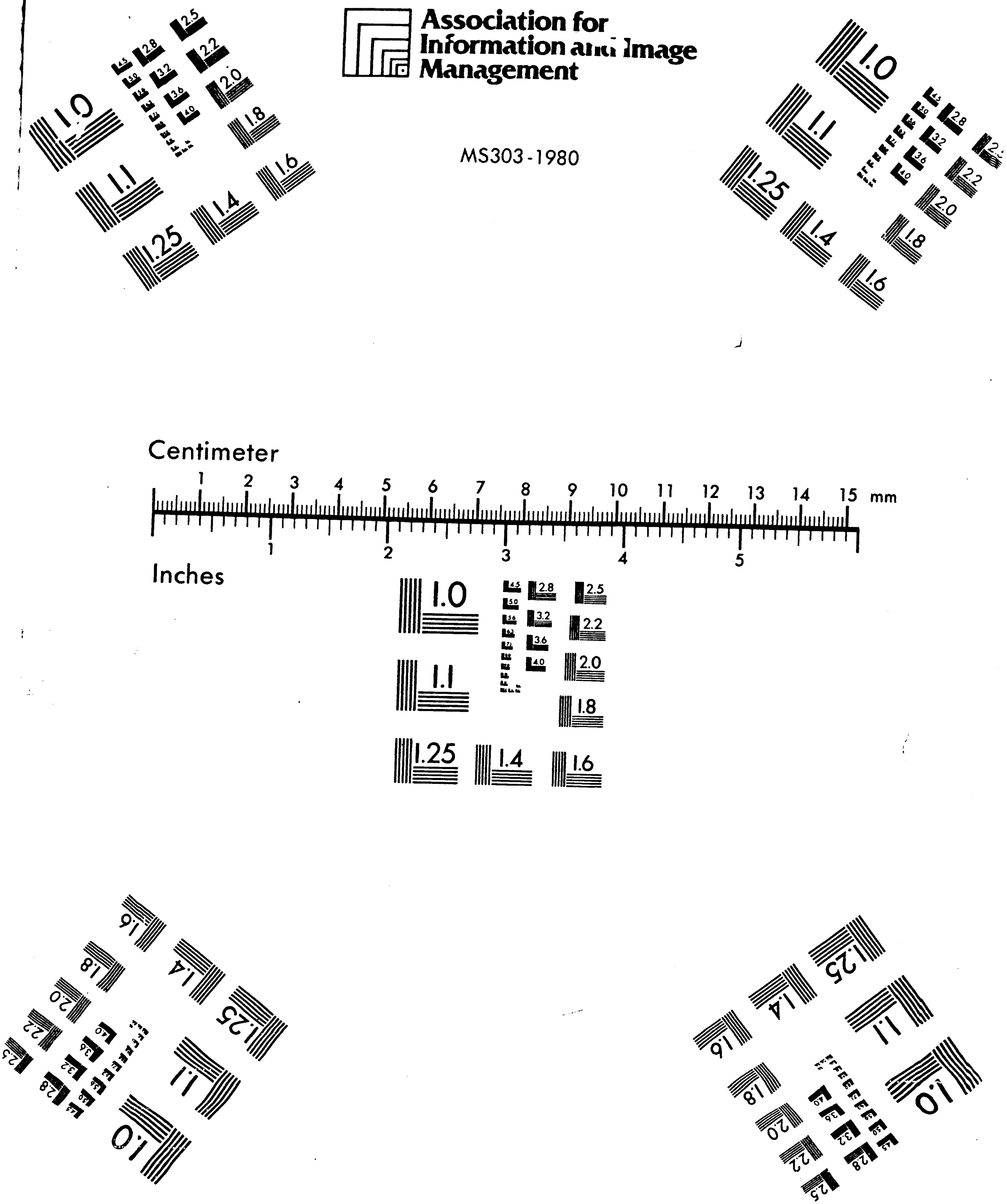

Association for Information and Image Management
MS303-1980
Centimeter
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Inches
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New York State
Department of Environmental Conservation

Division of Water

Spring Run

Biological Assessment

2001 Survey

GEORGE E. PATAKI, *Governor*

ERIN M. CROTTY, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Spring Run
Saratoga County, New York

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

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CONTENTS

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 I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT value, and 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.

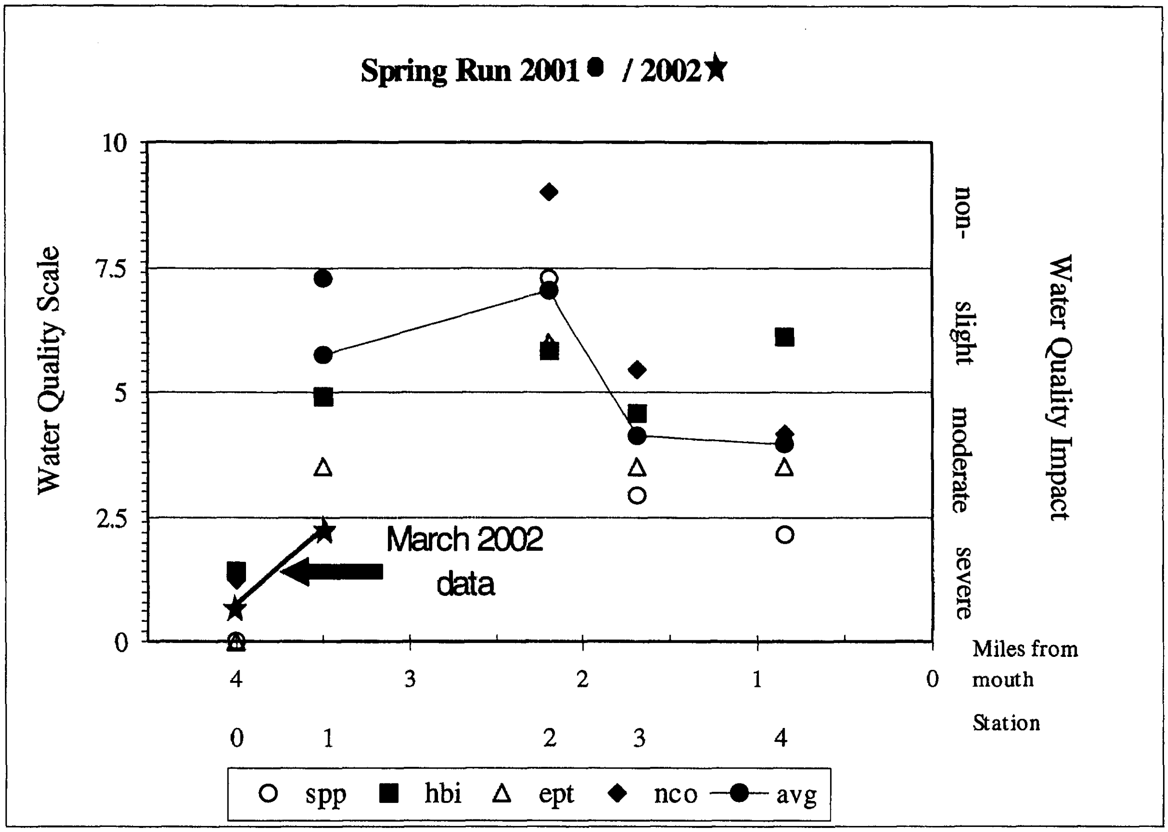
Based on the initial sampling in August, 2001, water quality in Spring Run was assessed as slightly impacted to moderately impacted (Figure 1). Because the habitats of Spring Run were dominated by gravel and sand rather than rubble, water quality assessments were obtained using sandy stream criteria (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, Spring Run 2001-02. 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, SPRING RUN					
Community Type	0 3/22/02	1 3/22/02	1 8/15/01	2 8/15/01	3 8/15/01	4 8/15/01
Natural: minimal human impacts	7	15	11	19	11	14
Nutrient additions; mostly nonpoint, agricultural	18	20	13	25	20	28
Toxic: industrial, municipal, or urban run-off	22	45	55	38	27	33
Organic: sewage effluent, animal wastes	42	50	37	36	34	44
Complex: municipal/industrial	62	84	46	74	60	59
Siltation	22	30	24	34	21	24
Impoundment	42	45	39	62 *	59 *	54 *

* the high impoundment values likely reflect sluggish stream conditions

TABLE SUMMARY

Station 0	Municipal and/or industrial wastes
Station 1 (2002)	Municipal and/or industrial wastes
Station 1 (2001)	Toxic wastes: municipal and/or industrial
Station 2	Municipal and/or industrial wastes
Station 3	Municipal and/or industrial wastes
Station 4	Municipal and/or industrial wastes

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

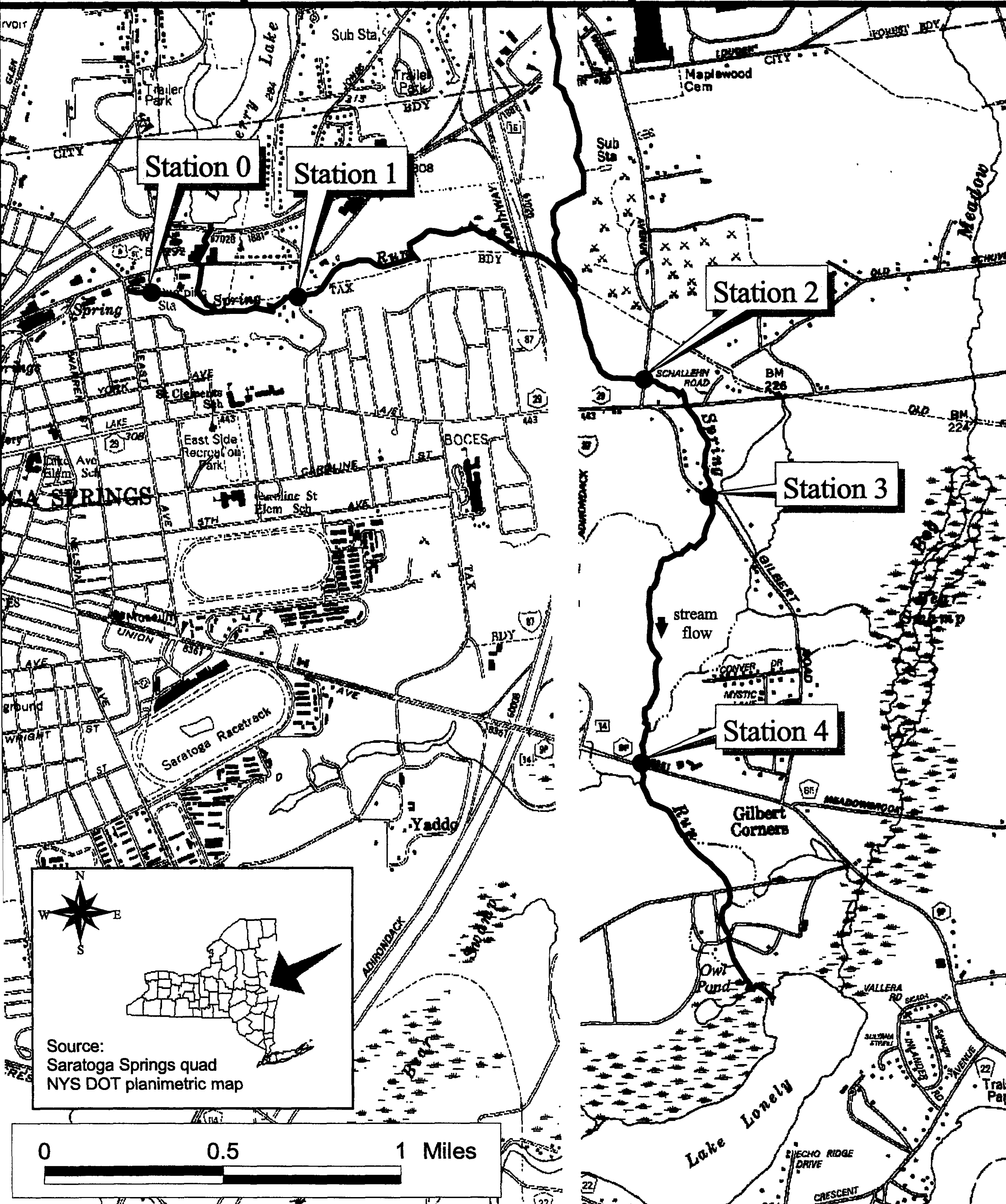


TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN SPRING RUN, SARATOGA COUNTY, NEW YORK, 2001-2002.

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	-		

Appendix I. BIOLOGICAL METHODS FOR KICK SAMPLING

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

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

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

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

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

Appendix II. MACROINVERTEBRATE COMMUNITY PARAMETERS FOR SANDY STREAMS

Stream habitats dominated by slow current speeds and smaller overall sediment particle size, mostly gravel, sand, and silt, require different methods of data analysis compared to streams with rubble/gravel riffles. The criteria used to interpret the invertebrate data and assess water quality were selected to account for habitat influences in order to separate water quality influences. The following indices and scales were used:

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 are: greater than 21, non-impacted; 17-21, slightly impacted; 12-16, moderately impacted; less than 12, severely impacted.

2. EPT richness. EPT denotes the total number of species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) found in an average 100-organism subsample. The scale for navigable waters was also used for this index. Expected ranges are: greater than 5, non-impacted; 4-5, slightly impacted; 2-3, moderately impacted; and 0-1, severely impacted.

3. Biotic index. The Hilsenhoff Biotic Index, the average tolerance value for all the organisms in the sample, ranges from intolerant (0) to tolerant (10). The scale of expected values set for slow sandy streams is: 0-5.50, non-impacted; 5.51-7.00, slightly impacted; 7.01-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. NCO richness. NCO 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. The scale used for slow sandy streams is: greater than 10, non-impacted; 6-10, slightly impacted; 2-5, moderately impacted; and 0-1, severely impacted.

These scales were developed using Long Island data in addition to data from several statewide sites with habitats similar to the Long Island streams. The scales were adjusted to make the indices corroborative, leading to accurate water quality assessments. Overall water quality is assigned by normalizing the four index values on a common ten-scale, and calculating the average of the four indices. Percent model affinity was not selected as an index, because there was no single prevailing community composition among the sites.

Appendix III. LEVELS OF WATER QUALITY IMPACT IN SANDY STREAMS.

The description of overall stream water quality in sandy streams 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, biotic index, EPT richness, and NCO richness. 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 net samples.

1. Non-impacted

Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 21 species in riffle habitats. Mayflies and caddisflies are represented; the EPT value is greater than 5. The biotic index value is 5.50 or less. NCO richness is greater than 10. 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 17-21. Mayflies may be restricted, with EPT values of 4-5. The biotic index value is 5.51-7.00. NCO richness is 6-10. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

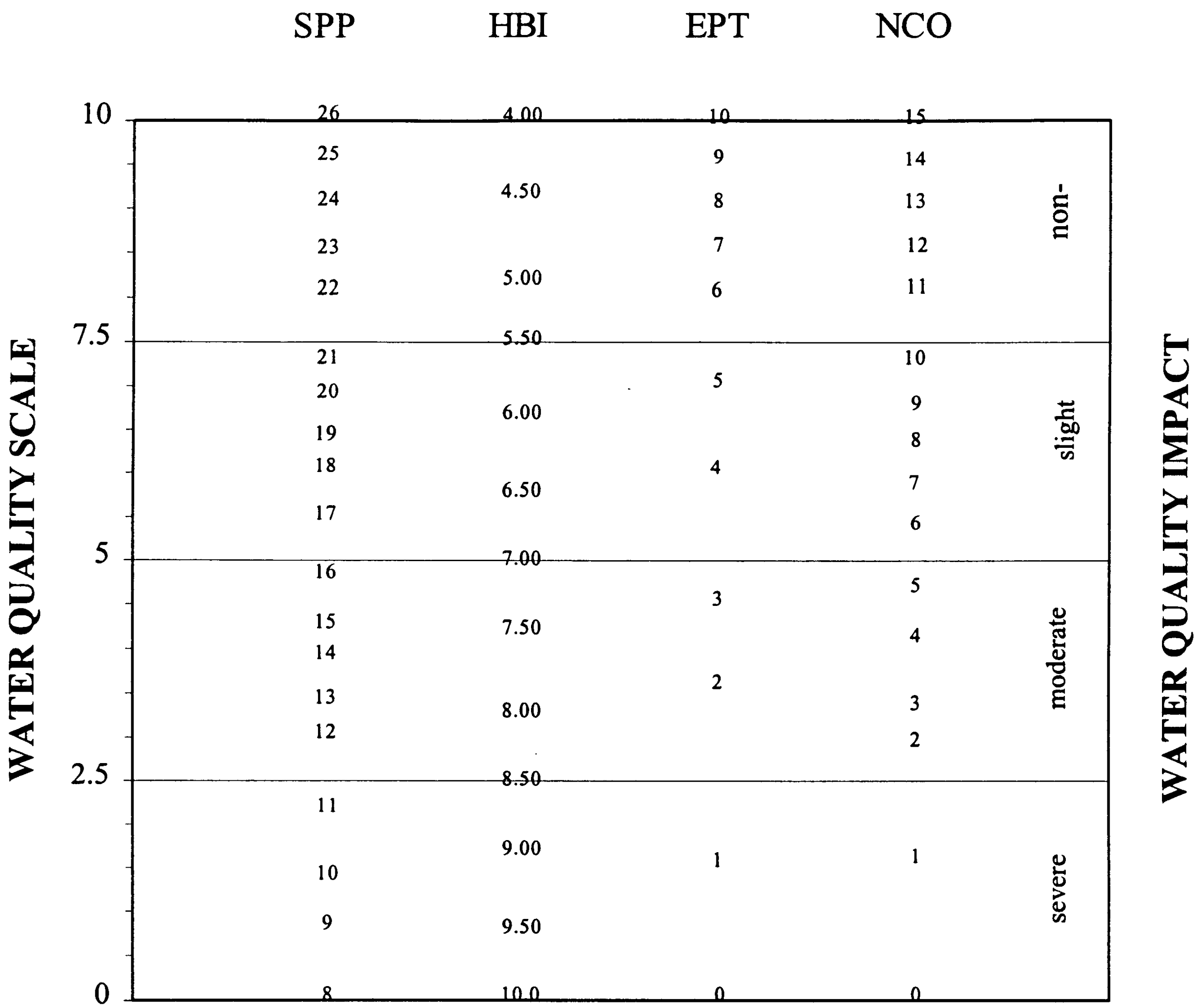
3. Moderately impacted

Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 12-16 species. Mayflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-3. The biotic index value is 7.01-8.50. NCO richness is 2-5. 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 12 or less. Mayflies and caddisflies are rare or absent; EPT value is 0-1. The biotic index value is greater than 8.50. NCO richness is 0-1, with nearly the entire fauna consisting of worms and midges. 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 FOR NET SAMPLES FROM SLOW, SANDY STREAMS



The Biological Assessment Profile of index values is a method of plotting biological index values on a common scale of water quality impact. For net samples from slow, sandy streams, these indices are used: SPP (species richness), HBI (Hilsenhoff Biotic Index), EPT (EPT richness), and NCO (NCO richness). Values from the four indices are converted to a common 0-10 scale as shown in this figure. The mean scale value of the four indices represents the assessed impact for each site.

Appendix V.
WATER QUALITY ASSESSMENT CRITERIA

for kick samples from riffles of non-navigable flowing waters:

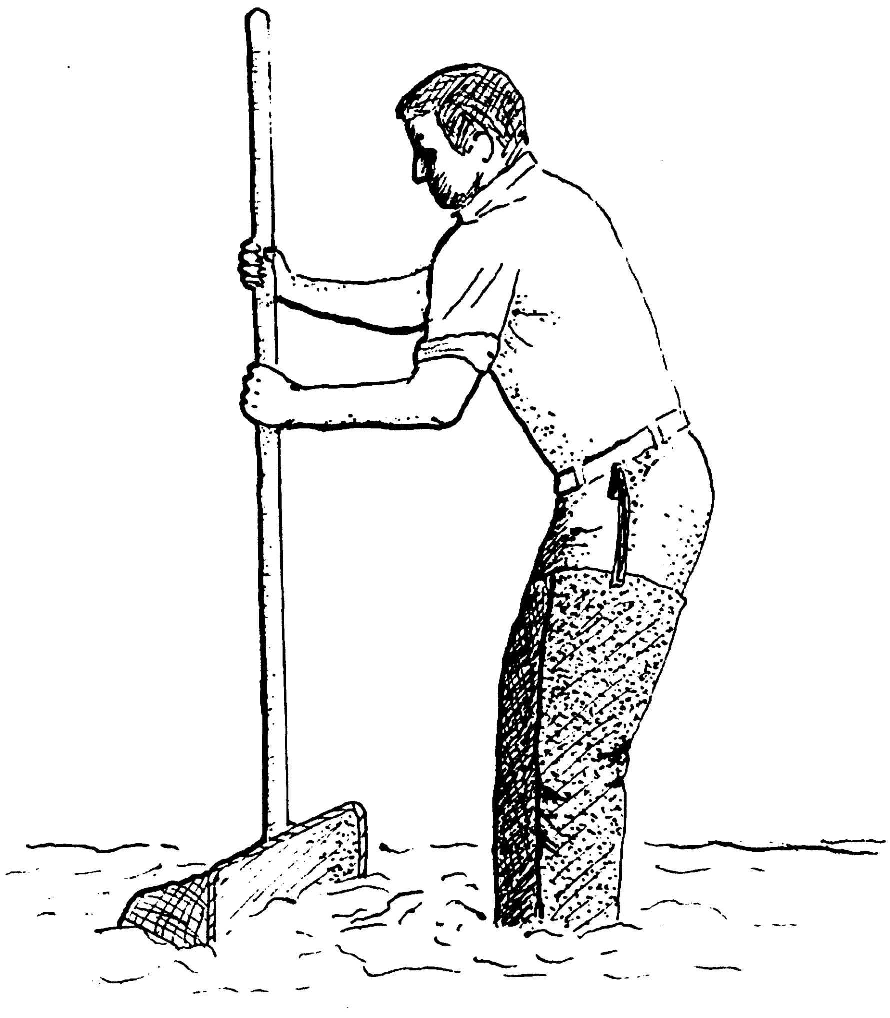
	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity
Non-Impacted	>26	0.00-4.50	>10	>64
Slightly Impacted	19-26	4.51-6.50	6-10	50-64
Moderately Impacted	11-18	6.51-8.50	2-5	35-49
Severely Impacted	0-10	8.51-10.00	0-1	<35

for net samples from sandy streams:

	Species Richness	Hilsenhoff Biotic Index	EPT Richness	NCO Richness
Non-Impacted	>21	0.00-5.50	>5	>10
Slightly Impacted	17-21	5.51-7.00	4-5	6-10
Moderately Impacted	12-16	7.01-8.50	2-3	2-5
Severely Impacted	0-11	8.51-10.00	0-1	0-1

Appendix VI.

THE TRAVELING KICK SAMPLE



← current

Rocks and sediment in the riffle are dislodged by foot upstream of a net; organisms dislodged are carried by the current into the net. Sampling is continued for five minutes, as the sampler gradually moves downstream to cover a distance of five meters.

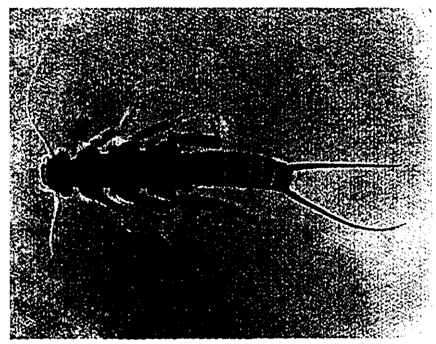
Appendix VII. A.

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.

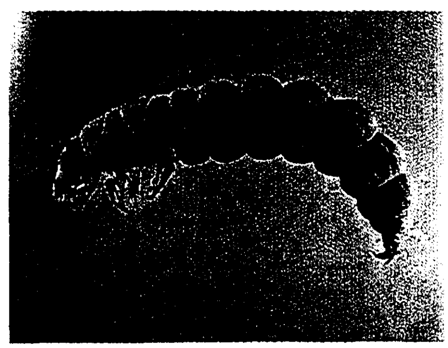
MAYFLIES

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

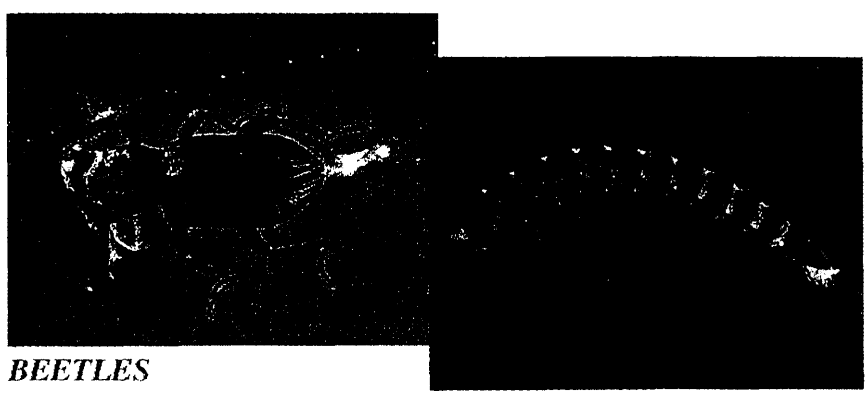
Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in nutrient-enriched stream segments.



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.

Appendix VII. B.



BEETLES

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

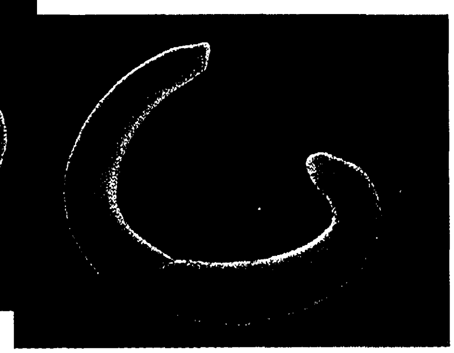
Midges are the most common aquatic flies. The larvae occur in almost any aquatic situation. Many species are very tolerant to pollution. Large, red midge larvae called "bloodworms" indicate organic enrichment. Other midge larvae filter plankton, indicating nutrient enrichment when numerous.

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

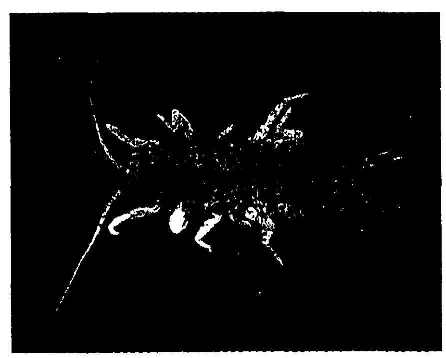
The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution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

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



SOWBUGS

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

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

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

NATURAL

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
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

	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

	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

SEWAGE EFFLUENT, ANIMAL WASTES

	A	B	C	D	E	F	G	H	I	J
LATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
LIGOCHAETA	5	35	15	10	10	35	40	10	20	15
IRUDINEA	-	-	-	-	-	-	-	-	-	-
ASTROPODA	-	-	-	-	-	-	-	-	-	-
?HAERIIDAE	-	-	-	10	-	-	-	-	-	-
SELLIDAE	5	10	-	10	10	10	10	50	-	5
AMMARIDAE	-	-	-	-	-	10	-	10	-	-
onychia	-	-	-	-	-	-	-	-	-	-
AETIDAE	-	10	10	5	-	-	-	-	5	-
EPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
EPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
PHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
aenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
LECOPTERA	-	-	-	-	-	-	-	-	-	-
ephenus	-	-	-	-	-	-	-	-	-	-
ptioservus	-	-	-	-	-	-	-	-	5	-
omoresia	-	-	-	-	-	-	-	-	-	-
enelmis	15	-	10	10	-	-	-	-	-	-
HILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
YDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
ELICOPSYCHIDAE/ RACHYCENTRIDAE/ HYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
MULIIDAE	-	-	-	-	-	-	-	-	-	-
mulium vittatum	-	-	-	25	10	35	-	-	5	5
MPIDIDAE	-	-	-	-	-	-	-	-	-	-
HIRONOMIDAE										
nypodinae	-	5	-	-	-	-	-	-	5	5
rdiocladius	-	-	-	-	-	-	-	-	-	-
icotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
ikiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
rametriocnemus	-	-	-	-	-	-	-	-	-	-
hironomus	-	-	-	-	-	-	10	-	-	60
lypedilum aviceps	-	-	-	-	-	-	-	-	-	-
lypedilum (all others)	10	10	10	10	60	-	30	10	5	5
nytarsini	10	10	10	10	-	-	-	10	40	-
TAL	100	100	100	100	100	100	100	100	100	100

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
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

APPENDIX XI. 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 mg/L 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 0.21, 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. Hunn. 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.