1.17 #349

New York State
Department of Environmental Conservation

Division of Water

Ellicott Creek

Biological Assessment

2001 Survey

GEORGE E. PATAKI, *Governor*   ERIN M. CROTTY, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Ellicott Creek
Erie County, New York

Survey date: July 31, 2001
Report date: March 15, 2002

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CONTENTS

Stream: Ellicott Creek, Erie County, New York

Reach: Alden Center to Amherst, New York

Background:

The Stream Biomonitoring Unit conducted biological sampling on Ellicott Creek on July 31, 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 7 sites, using methods described in the Quality Assurance document (Bode et al., 1996) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT value, and percent model affinity (see Appendices II and III). Table 2 provides a listing of sampling sites, and Table 4 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.

Thanks are extended to Michael Wilkinson, DEC Region 9 Fisheries, for his assistance in this survey.

Results and Conclusions:

1. Based on macroinvertebrate indicators, water quality in Ellicott Creek ranged from slightly impacted to moderately impacted, reflecting water quality mid-way between good and poor.

2. Specific conductance was high for most of the length of the creek. The cause of impact at most sites was nonpoint source runoff. Municipal/industrial sources were indicated at sites in Amherst. Several golf courses in this area also likely contribute nutrients and pesticides to the stream.

3. Fish sampling at the macroinvertebrate sampling sites showed similar trends. Based on the consensus assessments combining fish and macroinvertebrate results, most sites on Ellicott Creek are assessed as slightly impacted; sites in Lancaster and Amherst are assessed as moderately impacted.

Discussion

Previous macroinvertebrate sampling of Ellicott Creek by the Stream Biomonitoring Unit has documented water quality ranging from slightly impacted to moderately impacted. The creek was sampled in 1993 and 1994 in Amherst, (New York State Department of Environmental Conservation,1997), and in 2000 in Amherst and Williamsville as part of the RIBS (Rotating Intensive Basin Studies) ambient water quality monitoring program. The 1993 and 1994 samplings documented moderate impact, while in 2000 only slight impact was found at both locations. The present survey was designed to document any spatial water quality trends in the creek.

Based on macroinvertebrate indicators, water quality in Ellicott Creek ranged from slightly impacted to moderately impacted (Figure 1a). The upper portion of the stream was characterized by slow-moving water, with long reaches of near-standing water resulting in impoundment effects on the resident invertebrate fauna at Stations 2-4 (see Table 1 and Appendix XII). Upstream of the Bowmansville site (Station 4), a tributary from a nearby quarry enters Ellicott Creek, augmenting the flow of the stream with cool, well-oxygenated water, although also contributing higher conductivity (2572 µmhos). Appendix XIII lists possible impacts of high conductivity. The net effect on the downstream invertebrate fauna was small, but sufficient to improve water quality in Ellicott Creek from moderately impacted at Station 3 to slightly impacted at Station 4.

Impacts detected in the lower portion of Ellicott Creek may be attributable to a variety of sources. Municipal/industrial sources were indicated at Stations 6-7 in Amherst. Several golf courses in this area also likely contribute nutrients and pesticides to the stream.

Results of the present survey may be compared to results of Erie County stream surveys conducted in 1973 (Puleo et al., 1974). In the 1973 study, odiferous sludge beds were common in the lower portion of Ellicott Creek. At Maple Road in Amherst (1.3 miles downstream of Station 6), oxygen levels dropped to 1 mg/l, reflecting the heavy influence of sewage discharges on the stream. Macroinvertebrate communities at this site were heavily dominated by tubificid worms and tolerant midge larvae. The Sheridan Avenue site (Station 6) contained many snails, black fly larvae, and alderfly larvae. The fauna at this site in the present survey shows substantial improvement, with invertebrates such as riffle beetles, water pennies, and caddisflies at Station 6. Overall, the stream appears to have improved from severely impacted to slightly impacted.

Fish sampling in Ellicott Creek at the macroinvertebrate sampling sites suggest similar trends (Figure 1b). For these assessments, a correction factor of 0.75 was applied, to offset the increased diversity exhibited by streams in western New York State compared to streams in central and eastern New York. Station 1 metrics were considered negatively influenced by low habitat diversity, and Station 2 metrics were somewhat inflated because of pond-like conditions, which increased diversity. Fish-based assessments and macroinvertebrate assessments were combined, in an attempt to represent the overall biological condition of the waterbody. Assessments for each site, represented by a ten-scale value, were averaged to form a consensus assessment. Based on the consensus assessments, most sites on Ellicott Creek are assessed as slightly impacted; sites in Lancaster and Amherst are assessed as moderately impacted.

Literature Cited:

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

New York State Department of Environmental Conservation. 1997. The Niagara River - Lake Erie Drainage Basin, Biennial Report, 1993-94. Rotating Intensive Basin Studies. New York State Department of Environmental Conservation, Technical Report. 109 pages + appends.

Puleo, J., M.C. Lanighan, and C.O. Masters. 1974. 1973 Erie County Stream Survey. Erie County Public Health Division, Buffalo, New York. 294 pages.

Overview of field data

On the date of sampling, July 31, 2001, Ellicott Creek at the sites sampled was 5-20 meters wide, 0.1-0.2 meters deep, and had current speeds of 50-110 cm/sec in riffles. Dissolved oxygen was 5.5-8.2 mg/l, specific conductance was 1022-2430 μmhos, pH was 7.8-8.0, and the temperature was 19.0-23.3 °C (66-74 °F). Measurements for each site are found on the field data summary sheets.

Figure 1a. Biological Assessment Profile of index values, Ellicott Creek, 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 Percent Model Affinity. See Appendix IV for more complete explanation.

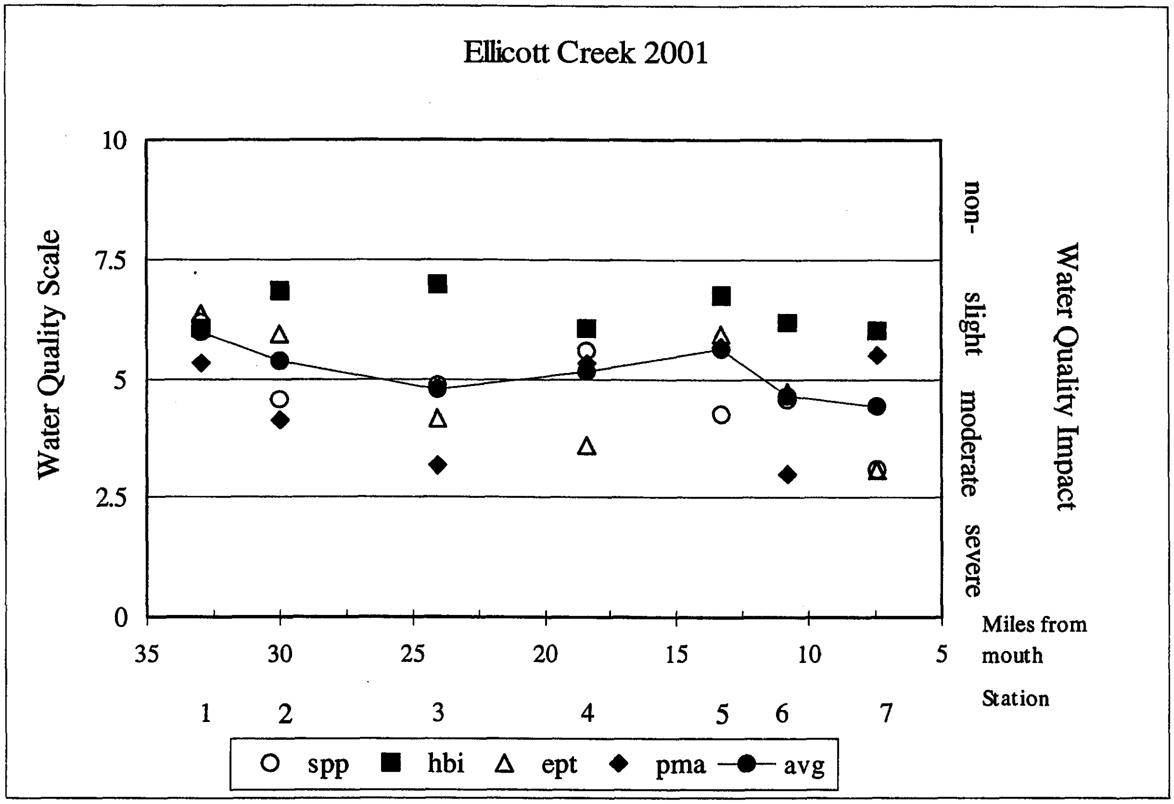


Figure 1b. Biological Assessment Profile of index values, Ellicott Creek, 2001. Values are plotted on a normalized scale of water quality. Comparison of macroinvertebrate and fish assessments.

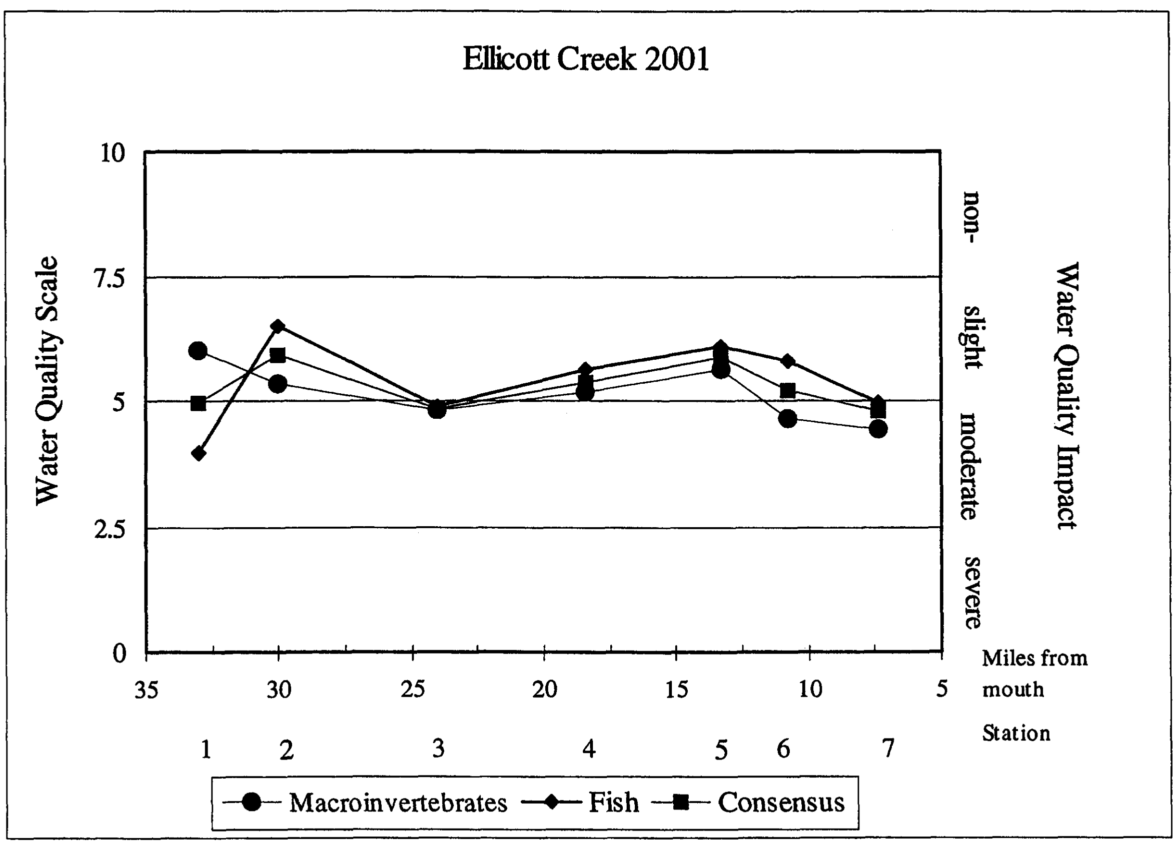


Table 1. Impact Source Determination, Ellicott Creek, 2001. Numbers represent similarity to community type models for each impact category. The highest similarities at each station within approximately 5% are highlighted. Similarities less than 50% are less conclusive.

	STATION, ELLICOTT CREEK						
Community Type	1	2	3	4	5	6	7
Natural: minimal human impacts	35	50	42	35	43	32	34
Nutrient additions; mostly nonpoint, agricultural	52	74	68	45	68	52	47
Toxic: industrial, municipal, or urban run-off	49	68	51	39	47	53	44
Organic: sewage effluent, animal wastes	36	51	44	33	46	34	37
Complex: municipal/industrial	46	42	38	49	49	48	57
Siltation	42	55	51	30	44	42	41
Impoundment	42	62	64	45	51	52	50

TABLE 2. STATION LOCATIONS FOR THE ELLICOTT CREEK, ERIE COUNTY, NEW YORK (see map).

STATION	LOCATION
01	Alden Center 20 meters below Sanbridge Rd. bridge 33.0 river miles above the mouth latitude/longitude: 42°54'59"; 78°31'23"
02	Wende 50 meters above Walden Ave. bridge 30.0 river miles above the mouth latitude/longitude: 42°56'05"; 78°33'09"
03	Lancaster Pavement Rd - under bridge 24.0 river miles above the mouth latitude/longitude: 42°56'17"; 78°37'21"
04	Bowmansville 100 meters below Main St. bridge 18.4 river miles above the mouth latitude/longitude: 42°56'32"; 78°41'11"
05	Williamsville in back of Tennis/ Racquet Club, off Mill St. 13.3 river miles above the mouth latitude/longitude: 42°58'06"; 78°44'44"
06	Amherst 50 meters below Sheridan Ave. bridge 10.8 river miles above the mouth latitude/longitude: 42°58'41" 78°45'51"
07	Amherst 30 meters below St. Rita's Lane bridge 7.4 river miles above the mouth latitude/longitude: 43°00'25"; 78°46'34"

Figure 2	Site Overview Map	Ellicott Creek

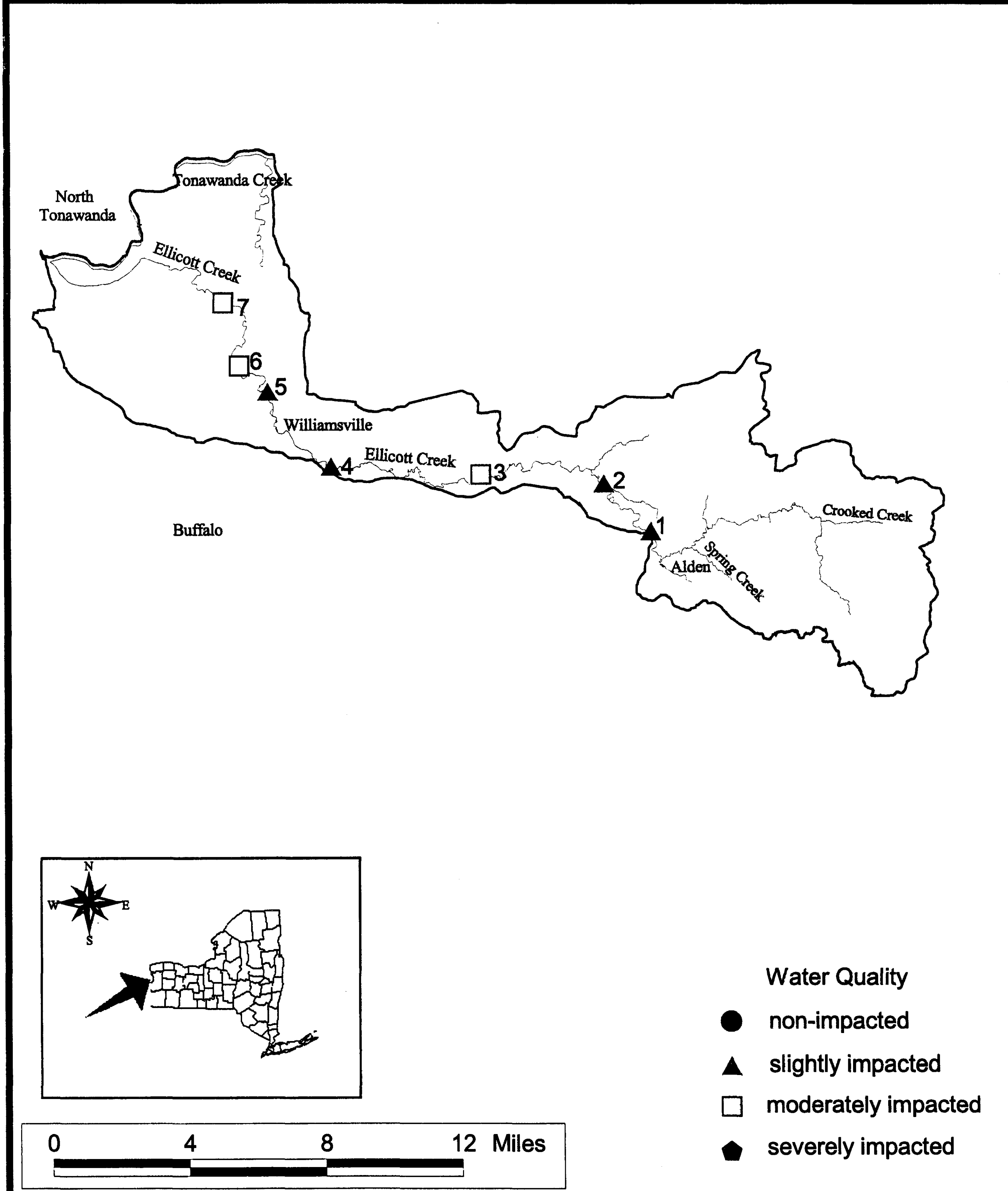


Figure 3a	Site Location Map	Ellicott Creek

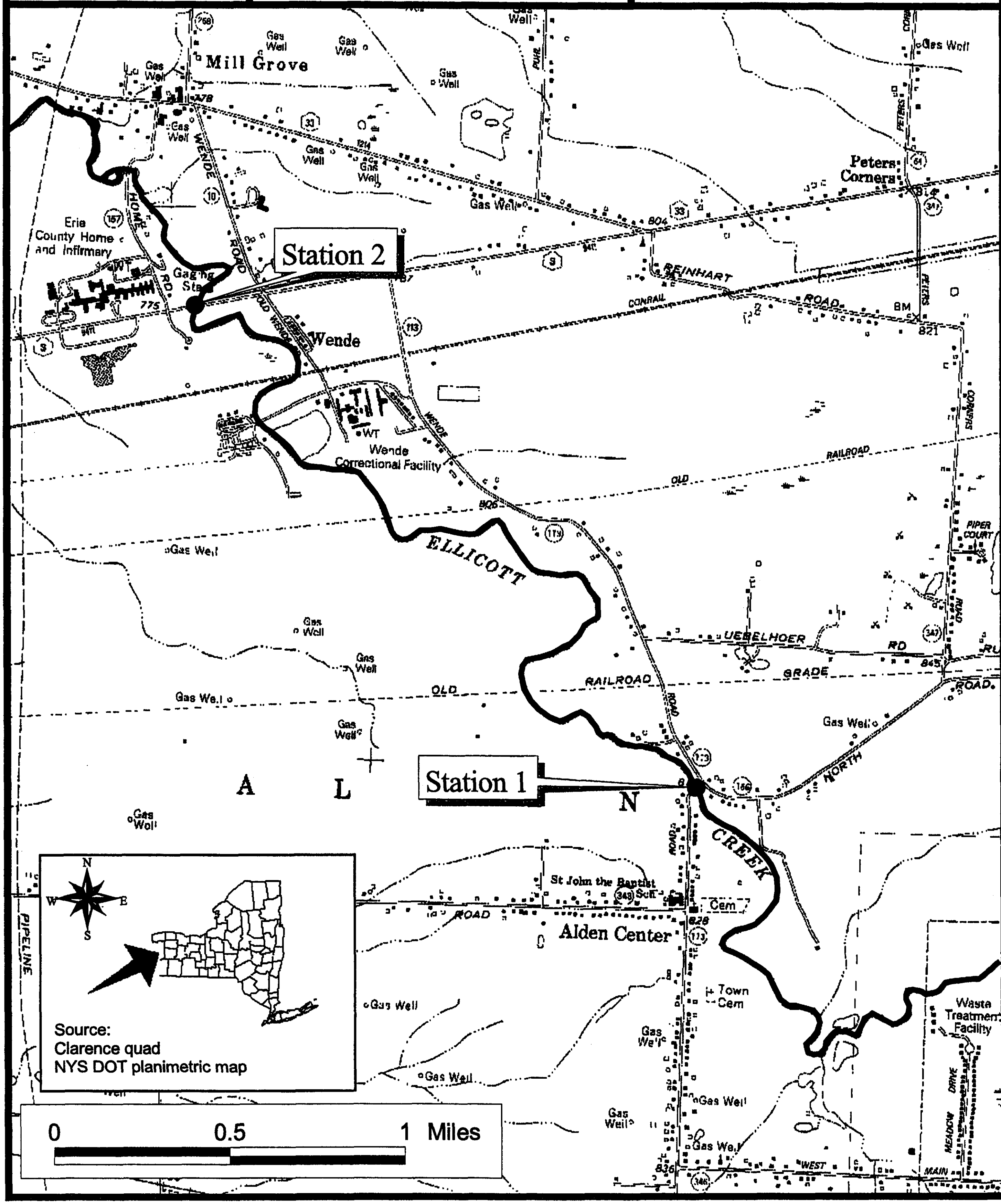


Figure 3b | Site Location Map | Ellicott Creek

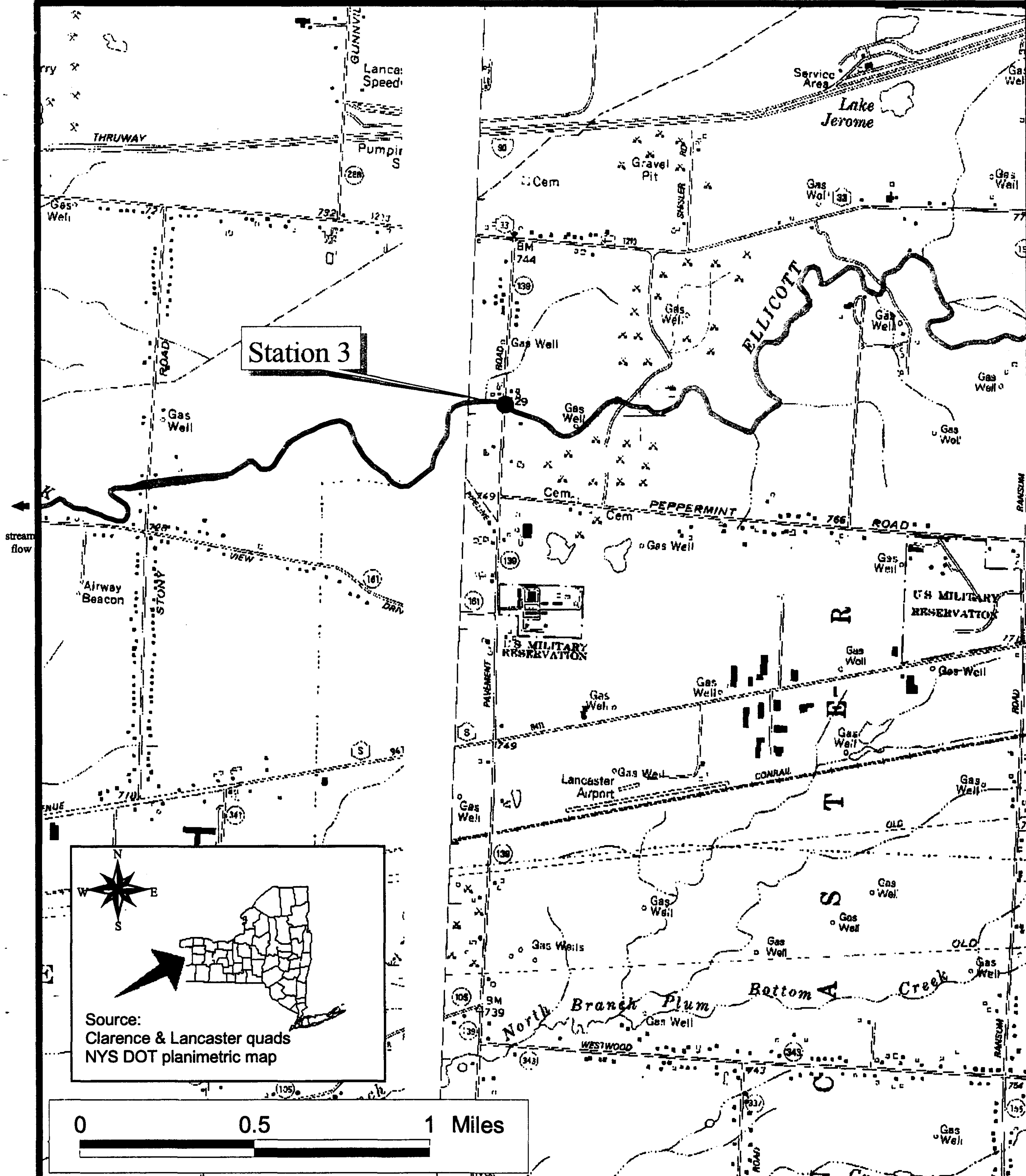


Figure 3c	Site Location Map	Ellicott Creek

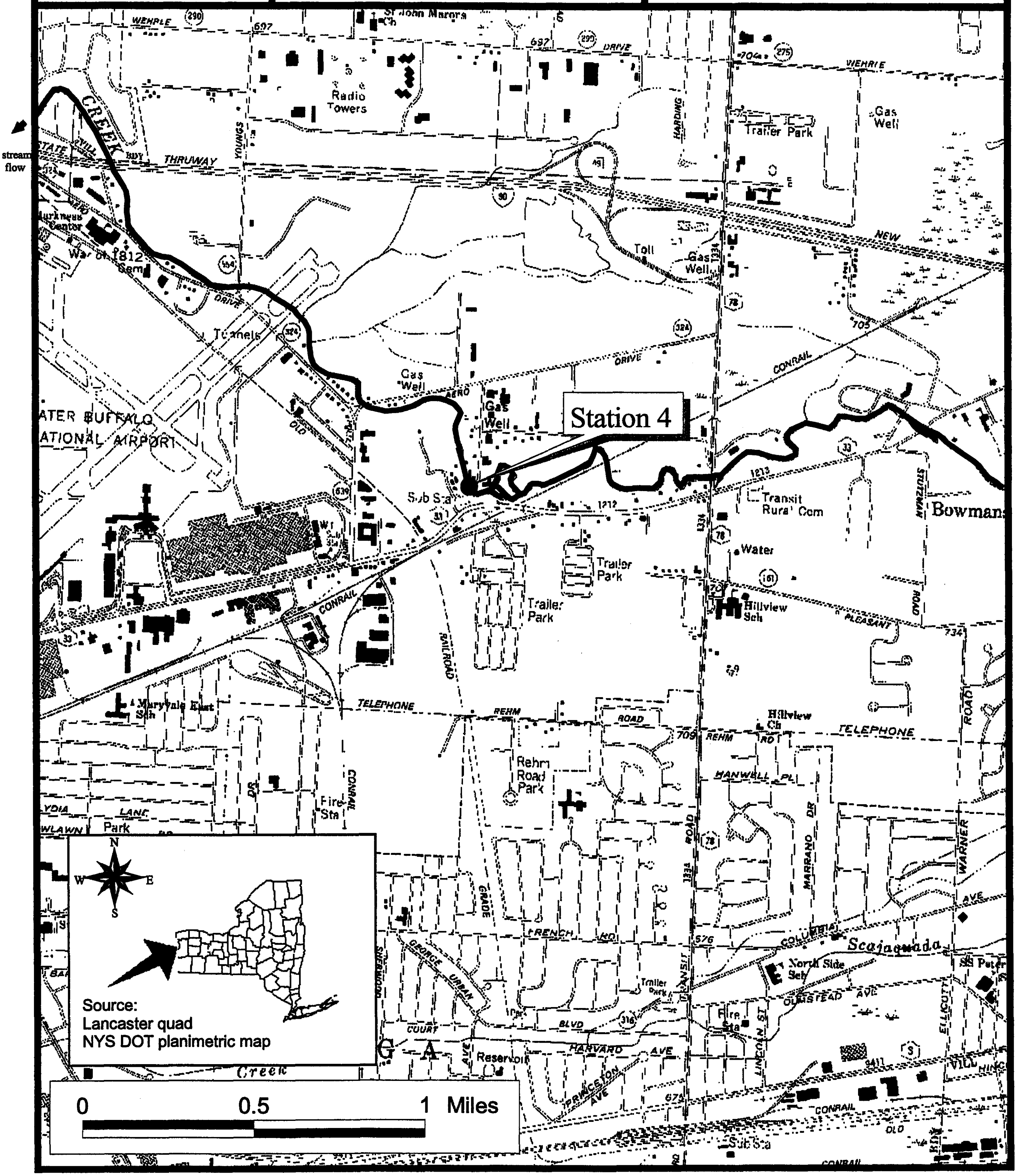
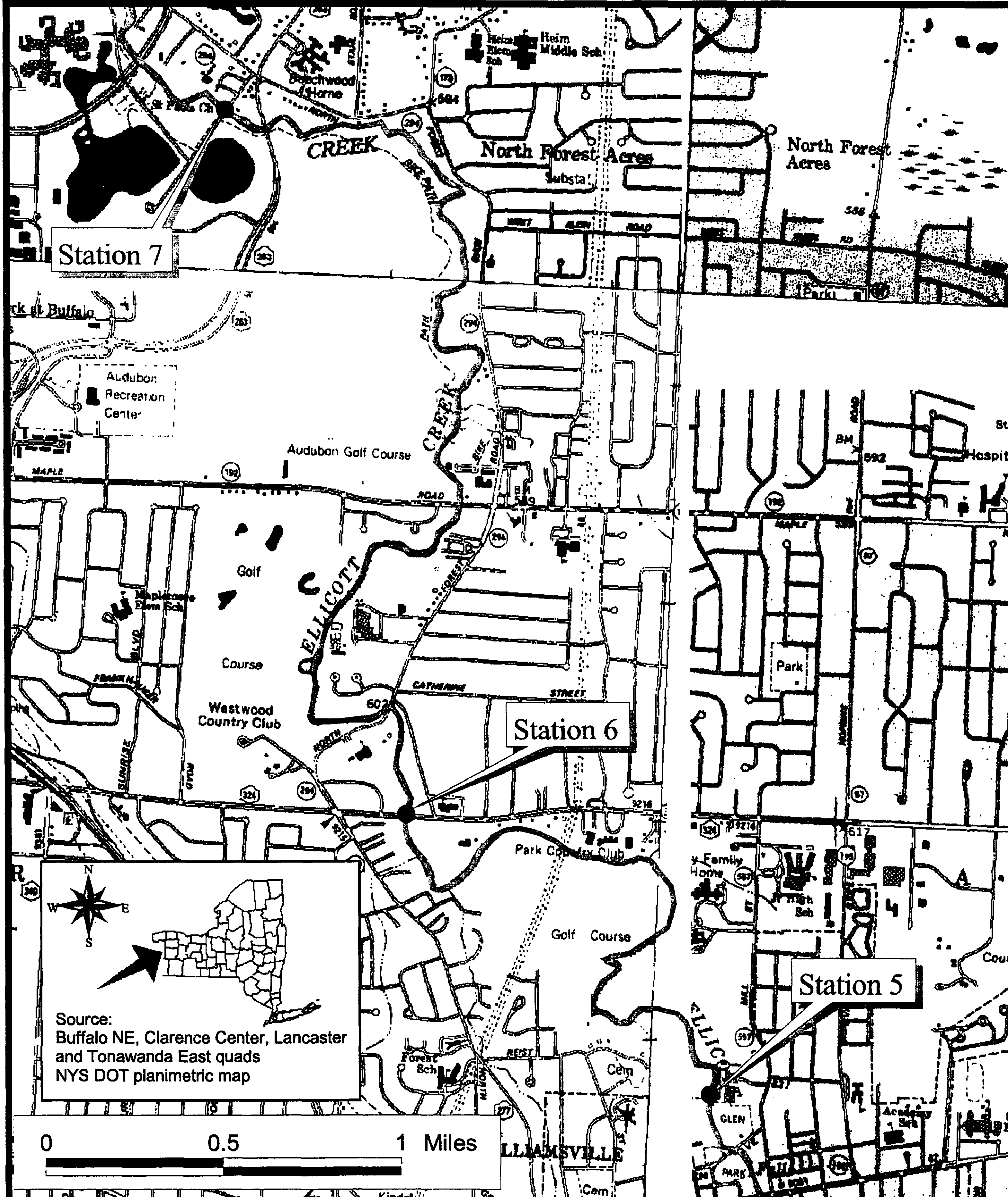


Figure 3d	Site Location Map	Ellicott Creek



stream flow

Table 3. Fish collections in Ellicott Creek, August 16 and September 5, 2001

	Station						
Common name	1	2	3	4	5	6	7
Central mudminnow	.	.	.	6	.	.	.
Northern pike	.	.	.	.	1	.	.
Central stoneroller	100	1	4	.	13	4	.
Common carp	.	.	.	.	.	.	4
Hornyhead chub	.	1	125	3	.	.	.
Striped shiner	20	10	98	4	.	15	1
Spotfin shiner	.	.	.	.	.	1	.
Bluntnose minnow	20	2	10	.	.	1	50
Blacknose dace	40	.	.	.	.	.	.
Creek chub	3	.	.	.	.	.	.
White sucker	2	5	3	15	2	2	5
N. hog sucker	.	2	1	12	3	2	5
Stonecat	.	2	.	.	.	.	.
Banded killifish	2	.	.	.	.	.	2
Rock bass	.	50	25	9	7	7	12
Green sunfish	.	.	.	.	1	.	.
Pumpkinseed	.	.	.	2	7	.	18
Bluegill	.	.	.	1	10	.	.
Smallmouth bass	.	.	3	1	4	3	.
Largemouth bass	.	.	.	.	.	1	2
Rainbow darter	20	40	10	40	40	30	25
Johnny darter	2	2	4	1	2	.	3
Logperch	.	.	.	.	1	.	2
Collection method	bbps	bbps	bbps seine	bbps seine	bbps seine	bbps seine	gbps once
Individuals	207	115	283	94	91	66	129
No. species	8	10	10	11	12	10	12
Weighted species	8	10	10	9	10	8	10
% non-tolerant ind.	40	92	54	77	71	88	53
% non-tolerant species	50	70	70	58	67	50	58
Trophic PMA	41	83	35	73	84	81	53
Profile value	5.3	8.6	6.5	7.5	8.1	7.5	6.6
Adjusted profile value (x .75)	4.0	6.5	4.9	5.6	6.1	5.8	5.0
Water quality assessment	mod	slt	mod	slt	slt	slt	mod

bbps=battery backpack shocker (DEC); gbps=gas backpack shocker (Smith Root)
seine= 50' bag seine

TABLE 4. MACROINVERTEBRATE SPECIES COLLECTED IN ELLICOTT CREEK, ERIE COUNTY, NEW YORK, JULY 31, 2001.

PLATYHELMINTHES
- Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - Lumbriculidae
    - Undetermined Lumbriculidae
  - Tubificidae
    - Undet. Tubificidae w/o cap. setae

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

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea sp.
  - AMPHIPODA
    - Gammaridae
      - Gammarus sp.
  - DECAPODA
    - Cambaridae
      - Undetermined Cambaridae
- INSECTA
  - EPHEMEROPTERA
    - Baetidae
      - Baetis flavistriga
      - Baetis intercalaris
    - Heptageniidae
      - Leucrocuta sp.
      - Stenacron interpunctatum
      - Stenonema terminatum
      - Undetermined Heptageniidae
  - COLEOPTERA
    - Hydrophilidae
      - Undetermined Hydrophilidae
    - Gyrinidae
      - Dineutus sp.
    - Psephenidae
      - Ectopria nervosa
      - Psephenus herricki
    - Elmidae
      - Optioservus fastiditus
      - Optioservus sp.
      - Stenelmis concinna
      - Stenelmis crenata
      - Stenelmis sp.
  - TRICHOPTERA
    - Philopotamidae
      - Chimarra obscura
    - Hydropsychidae
      - Cheumatopsyche sp.
      - Hydropsyche betteni
      - Hydropsyche bronta
      - Hydropsyche sparna
    - Hydroptilidae
      - Hydroptila nr. armata
      - Hydroptila sp.
  - DIPTERA
    - Tipulidae
      - Tipula sp.
    - Simuliidae
      - Simulium tuberosum
      - Simulium vittatum
      - Simulium sp.
    - Empididae
      - Hemerodromia sp.
    - Chironomidae
      - Tanypodinae
        - Thienemannimyia gr. spp.
      - Diamesinae
        - Pagastia sp. A
      - Orthocladiinae
        - Cricotopus bicinctus
        - Cricotopus tremulus gr.
        - Cricotopus trifascia gr.
        - Eukiefferiella devonica gr.
        - Nanocladius sp.
        - Parametriocnemus lundbecki
        - Tvetenia vitracies
      - Chironominae
        - Chironomini
          - Polypedilum convictum
          - Polypedilum illinoense
        - Tanytarsini
          - Rheotanytarsus exiguus gr.
          - Tanytarsus glabrescens gr.

STREAM SITE: Ellicott Creek, Station 1
LOCATION: Alden Center, New York, downstream of Sanbridge Road
DATE: July 31 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	1
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	1
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	5
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	1
		Baetis intercalaris	3
	Heptageniidae	Undetermined Heptageniidae	1
COLEOPTERA	Hydrophilidae	Undetermined Hydrophilidae	1
	Elmidae	Optioservus fastiditus	2
		Stenelmis crenata	6
TRICHOPTERA	Philopotamidae	Chimarra obscura	2
	Hydropsychidae	Cheumatopsyche sp.	14
		Hydropsyche betteni	10
		Hydropsyche bronta	1
	Hydroptilidae	Hydroptila nr. armata	17
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	7
		Cricotopus bicinctus	3
		Nanocladius sp.	1
		Parametriocnemus lundbecki	1
		Tvetenia vitracies	1
		Polypedilum convictum	4
		Rheotanytarsus exiguus gr.	16
		Tanytarsus glabrescens gr.	2

SPECIES RICHNESS 22 (good)
BIOTIC INDEX 5.67 (good)
EPT RICHNESS 8 (good)
MODEL AFFINITY 51 (good)
ASSESSMENT slightly impacted

DESCRIPTION The sample was taken 20 meters downstream of the Sandbridge Road bridge in Alden Center. Both streambanks downstream of the bridge appeared recently reinforced with rip rap. The macroinvertebrate fauna was heavily dominated by facultative caddisflies and midges, and all metrics were within the range of slight impact.

STREAM SITE: Ellicott Creek, Station 2
LOCATION: Wende, New York, upstream of Walden Avenue
DATE: July 31 2001
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	7
ANNELIDA			
OLIGOCHAETA	Lumbriculidae	Undetermined Lumbriculidae	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp.	1
AMPHIPODA	Gammaridae	Gammarus sp.	3
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis intercalaris	2
	Heptageniidae	Leucrocuta sp.	1
		Stenacron interpunctatum	2
		Stenonema terminatum	1
COLEOPTERA	Psephenidae	Ectopria nervosa	1
		Psephenus herricki	1
	Elmidae	Optioservus fastiditus	14
		Stenelmis crenata	31
TRICHOPTERA	Philopotamidae	Chimarra obscura	1
	Hydropsychidae	Cheumatopsyche sp.	26
		Hydropsyche betteni	1
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	4
		Polypedilum convictum	3

SPECIES RICHNESS 17 (poor)
BIOTIC INDEX 5.04 (good)
EPT RICHNESS 7 (good)
MODEL AFFINITY 44 (poor)
ASSESSMENT slightly impacted

DESCRIPTION The sampling site was 50 meters upstream of the Walden Avenue bridge in Wende. Although the riffle provided adequate habitat for invertebrates, both upstream and downstream were composed of long reaches of slow-moving water. The fauna was dominated by riffle beetles and caddisflies, and water quality was assessed as slightly impacted.

STREAM SITE:	Ellicott Creek, Station 3
LOCATION:	Lancaster, New York, at Pavement Road
DATE:	July 31 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	1
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	3
DECAPODA	Cambaridae	Undetermined Cambaridae	2
INSECTA			
EPHEMEROPTERA	Heptageniidae	Stenacron interpunctatum	1
ODONATA	Coenagrionidae	Undetermined Coenagrionidae	1
COLEOPTERA	Gyrinidae	Dineutus sp.	1
	Psephenidae	Psephenus herricki	5
	Elmidae	Optioservus sp.	7
		Stenelmis concinna	8
		Stenelmis crenata	15
TRICHOPTERA	Philopotamidae	Chimarra obscura	22
	Hydropsychidae	Cheumatopsyche sp.	16
		Hydropsyche betteni	8
DIPTERA	Simuliidae	Simulium vittatum	1
		Simulium sp.	1
	Chironomidae	Thienemannimyia gr. spp.	3
		Polypedilum convictum	4

SPECIES RICHNESS	18 (poor)
BIOTIC INDEX	4.94 (good)
EPT RICHNESS	4 (poor)
MODEL AFFINITY	38 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION The kick sample was taken directly under the Pavement Road bridge in Lancaster. The macroinvertebrate fauna was similar to that at Station 2. However, due to a decrease in mayfly richness, the water quality assessment worsened to moderately impacted.

STREAM SITE:	Ellicott Creek, Station 4
LOCATION:	Bowmansville, New York, downstream of Main Street
DATE:	July 31 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	9
ANNELIDA			
OLIGOCHAETA	Tubificidae	Und. Tubificidae w/o cap. setae	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea sp.	1
AMPHIPODA	Gammaridae	Gammarus sp.	30
INSECTA			
EPHEMEROPTERA	Heptageniidae	Stenacron interpunctatum	1
COLEOPTERA	Psephenidae	Psephenus herricki	4
	Elmidae	Optioservus sp.	1
		Stenelmis crenata	7
TRICHOPTERA	Philopotamidae	Chimarra obscura	7
	Hydropsychidae	Cheumatopsyche sp.	2
DIPTERA	Tipulidae	Tipula sp.	1
	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia sp. A	1
		Cricotopus bicinctus	5
		Cricotopus trifascia gr.	1
		Eukiefferiella devonica gr.	2
		Parametriocnemus lundbecki	1
		Tvetenia vitracies	4
		Polypedilum convictum	20
		Rheotanytarsus exiguus gr.	1

SPECIES RICHNESS	20 (good)
BIOTIC INDEX	5.65 (good)
EPT RICHNESS	3 (poor)
MODEL AFFINITY	51 (good)
ASSESSMENT	slightly impacted

DESCRIPTION The sampling site was 100 meters downstream of the Main Street bridge in Bowmansville, accessed by the Bowmansville Fire Department. The river was much wider here than at Station 3, and conductivity more than doubled. The macroinvertebrate fauna was dominated by midges and scuds. The metrics were mixed, but overall water quality was within the range of slight impact.

STREAM SITE:	Ellicott Creek, Station 5
LOCATION:	Williamsville, New York, off Mill Street
DATE:	July 31 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	3
		Baetis intercalaris	1
	Heptageniidae	Stenacron interpunctatum	1
COLEOPTERA	Elmidae	Optioservus fastiditus	9
		Stenelmis sp.	2
TRICHOPTERA	Philopotamidae	Chimarra obscura	18
	Hydropsychidae	Cheumatopsyche sp.	14
		Hydropsyche betteni	4
		Hydropsyche sparna	15
DIPTERA	Simuliidae	Simulium tuberosum	1
	Empididae	Hemerodromia sp.	7
	Chironomidae	Thienemannimyia gr. spp.	1
		Pagastia sp. A	2
		Tvetenia vitracies	2
		Polypedilum convictum	19
		Rheotanytarsus exiguus gr.	1

SPECIES RICHNESS	16 (poor)
BIOTIC INDEX	5.10 (good)
EPT RICHNESS	7 (good)
MODEL AFFINITY	53 (good)
ASSESSMENT	slightly impacted

DESCRIPTION This site was accessed in back of the Village Glen Tennis and Fitness Club. The habitat appeared good, with an adequate current and a pool/riffle combination. The macroinvertebrate fauna was dominated by caddisflies and midges, with most metrics improving from Station 4. Water quality was assessed as slightly impacted.

STREAM SITE:	Ellicott Creek, Station 6
LOCATION:	Williamsville, New York, downstream of Sheridan Avenue
DATE:	July 31 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

MOLLUSCA			
GASTROPODA	Pleuroceridae	Undetermined Pleuroceridae	1
PELECYPODA	Sphaeriidae	Undetermined Sphaeriidae	2
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	32
INSECTA			
COLEOPTERA	Psephenidae	Psephenus herricki	4
	Elmidae	Optioservus fastiditus	30
		Stenelmis crenata	1
TRICHOPTERA	Philopotamidae	Chimarra obscura	1
	Hydropsychidae	Cheumatopsyche sp.	7
		Hydropsyche betteni	4
		Hydropsyche sparna	6
	Hydroptilidae	Hydroptila sp.	1
DIPTERA	Simuliidae	Simulium vittatum	2
	Empididae	Hemerodromia sp.	2
	Chironomidae	Thienemannimyia gr. spp.	2
		Cricotopus tremulus	1
		Polypedilum illinoense	2
		Rheotanytarsus exiguus gr.	2

SPECIES RICHNESS	17 (poor)
BIOTIC INDEX	5.54 (good)
EPT RICHNESS	5 (poor)
MODEL AFFINITY	37 (poor)
ASSESSMENT	moderately impacted

DESCRIPTION The sampling site was located 50 meters downstream of the Sheridan Avenue bridge in Lancaster. The macroinvertebrate fauna was dominated by beetles and scuds. Most of the metrics values were poor, and water quality was assessed as moderately impacted.

STREAM SITE:	Ellicott Creek, Station 7
LOCATION:	Williamsville, New York, downstream of St. Rita's Lane
DATE:	July 31 2001
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	8
MOLLUSCA			
PELECYPODA	Sphaeriidae	Pisidium sp.	2
		Sphaerium sp.	1
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	17
INSECTA			
EPHEMEROPTERA	Baetidae	Baetis flavistriga	2
COLEOPTERA	Psephenidae	Ectopria nervosa	1
	Elmidae	Stenelmis crenata	19
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	10
DIPTERA	Chironomidae	Cricotopus bicinctus	5
		Tvetenia vitracies	2
		Polypedilum convictum	27
		Rheotanytarsus exiguus gr.	6

SPECIES RICHNESS	12 (poor)
BIOTIC INDEX	5.69 (good)
EPT RICHNESS	2 (poor)
MODEL AFFINITY	52 (good)
ASSESSMENT	moderately impacted

DESCRIPTION The kick sample was taken 30 meters downstream of St. Rita's Lane in Amherst. The riffle had an adequate current, but was highly embedded. The macroinvertebrate fauna was dominated by facultative organisms, and overall water quality was assessed as moderately impacted.

FIELD DATA SUMMARY

STREAM NAME: Ellicott Creek **DATE SAMPLED: 07/31/01**
REACH: Alden Center to Lancaster
FIELD PERSONNEL INVOLVED: Abele, Bode, Wilkinson

STATION	01	02	03	04
ARRIVAL TIME AT STATION	8:50	9:25	10:00	10:45
LOCATION	Alden Center	Wende	Lancaster	Bowmansville
PHYSICAL CHARACTERISTICS				
Width (meters)	8	5	8	20
Depth (meters)	0.1	0.1	0.1	0.2
Current speed (cm per sec.)	50	50	50	90
Substrate (%)				
Rock (>25.4 cm, or bedrock)	0	10	20	20
Rubble (6.35 - 25.4 cm)	30	20	20	30
Gravel (0.2 – 6.35 cm)	40	30	30	20
Sand (0.06 – 2.0 mm)	20	20	20	10
Silt (0.004 – 0.06 mm)	10	20	20	20
Embeddedness (%)	40	30	20	-
CHEMICAL MEASUREMENTS				
Temperature (° C)	19.0	20.7	21.4	21.0
Specific Conductance (μmhos)	1176	1022	1143	2430
Dissolved Oxygen (mg/l)	7.9	5.5	6.1	8.1
pH	7.8	7.9	7.7	7.8
BIOLOGICAL ATTRIBUTES				
Canopy (%)	5	50	50	25
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous	abundant			
algae - diatoms			present	
macrophytes or moss	duckweed		present	
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X	X	X	X
Megaloptera(dobsonflies,alderflies)				
Odonata (dragonflies, damselflies)		X		
Chironomidae (midges)		X	X	
Simuliidae (black flies)			X	X
Decapoda (crayfish)	X	X	X	X
Gammaridae (scuds)	X			X
Mollusca (snails, clams)	X	X	X	
Oligochaeta (worms)				
Other		X		X
FIELD ASSESSMENT	good	good	good	good

FIELD DATA SUMMARY				
STREAM NAME: Ellicott Creek DATE SAMPLED: 07/31/01				
REACH: Alden Center to Lancaster				
FIELD PERSONNEL INVOLVED: Abele, Bode, Wilkinson				
STATION	05	06	07	
ARRIVAL TIME AT STATION	11:35	12:30	12:50	
LOCATION	Williamsville	Amherst	Amherst	
PHYSICAL CHARACTERISTICS				
Width (meters)	15	20	20	
Depth (meters)	0.1	0.2	0.1	
Current speed (cm per sec.)	90	110	100	
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	0	0	
Rubble (6.35 - 25.4 cm)	30	40	30	
Gravel (0.2 – 6.35 cm)	30	20	20	
Sand (0.06 – 2.0 mm)	20	20	20	
Silt (0.004 – 0.06 mm)	10	20	30	
Embeddedness (%)	20	20	50	
CHEMICAL MEASUREMENTS				
Temperature (° C)	22.2	21.8	23.3	
Specific Conductance (umhos)	2220	2260	2302	
Dissolved Oxygen (mg/l)	8.2	7.9	8.1	
pH	8.0	7.9	7.9	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	20	10	0	
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous			present	
algae - diatoms	present		present	
macrophytes or moss		present	present	
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)				
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)		X	X	
Megaloptera (dobsonflies, alderflies)				
Odonata (dragonflies, damselflies)				
Chironomidae (midges)		X	X	
Simuliidae (black flies)		X	X	
Decapoda (crayfish)	X	X	X	
Gammaridae (scuds)		X	X	
Mollusca (snails, clams)		X	X	
Oligochaeta (worms)		X		
Other	X			
FIELD ASSESSMENT	poor	poor	poor	

LABORATORY DATA SUMMARY				
STREAM NAME: Ellicott Creek		**DRAINAGE: 01**		
DATE SAMPLED: 07/31/01		**COUNTY: Erie**		
SAMPLING METHOD: Traveling kick				
STATION	01	02	03	04
LOCATION	Alden Center	Wende	Lancaster	Bowmanville
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Hydroptila nr. armata	Stenelmis crenata	Chimarra obscura	Gammarus sp.
	17 %	31 %	22 %	30 %
	facultative	facultative	intolerant	facultative
	caddisfly	beetle	caddisfly	scud
2.	Rheotanytarsus exiguus gr.	Cheumatopsyche sp.	Cheumatopsyche sp.	Polypedilum convictum
Intolerant = not tolerant of poor	16 %	26 %	16 %	20 %
water quality	facultative	facultative	facultative	facultative
	midge	caddisfly	caddisfly	midge
3.	Cheumatopsyche sp.	Optioservus fastiditus	Stenelmis crenata	Undetermined Turbellaria
Facultative = occurring over a	14 %	14 %	15 %	9 %
wide range of water quality	facultative	intolerant	facultative	facultative
	caddisfly	beetle	beetle	flatworm
4.	Hydropsyche betteni	Undetermined Turbellaria	Stenelmis concinna	Stenelmis crenata
Tolerant = tolerant of poor	10 %	7 %	8 %	7 %
water quality	facultative	facultative	facultative	facultative
	caddisfly	flatworm	beetle	beetle
5.	Thienemannimyia gr. spp.	Thienemannimyia gr. spp.	Hydropsyche betteni	Chimarra obscura
	7 %	4 %	8 %	7 %
	facultative	facultative	facultative	intolerant
	midge	midge	caddisfly	caddisfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	35 (8)	7 (2)	7 (2)	36 (9)
Trichoptera (caddisflies)	44 (5)	28 (3)	4 (3)	9 (2)
Ephemeroptera (mayflies)	5 (3)	6 (4)	1 (1)	1 (1)
Plecoptera (stoneflies)	0 (0)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)	9 (3)	47 (4)	36 (5)	12 (3)
Oligochaeta (worms)	0 (0)	1 (1)	0 (0)	1 (1)
Other	1 (1)	7 (1)	1 (1)	9 (1)
SPECIES RICHNESS	22	17	18	20
BIOTIC INDEX	5.67	5.04	4.94	5.65
EPT RICHNESS	8	7	4	3
PERCENT MODEL AFFINITY	51	44	38	51
FIELD ASSESSMENT	good	good	good	good
OVERALL ASSESSMENT	slightly impacted	slightly impacted	moderately impacted	slightly impacted

LABORATORY DATA SUMMARY				
STREAM NAME: Ellicott Creek	**DRAINAGE: 01**			
DATE SAMPLED: 07/31/01	**COUNTY: Erie**			
SAMPLING METHOD: Traveling kick				
STATION	05	06	07	
LOCATION	Williamsville	Amherst	Amherst	
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Polypedilum convictum	Gammarus sp.	Polypedilum convictum	
	19 %	32 %	27 %	
	facultative	facultative	facultative	
	midge	scud	midge	
2.	Chimarra obscura	Stenelmis crenata	Stenelmis crenata	
Intolerant = not tolerant of poor	18 %	30 %	19 %	
water quality	intolerant	facultative	facultative	
	caddisfly	beetle	beetle	
3.	Hydropsyche sparna	Cheumatopsyche sp.	Gammarus sp.	
Facultative = occurring over a	15 %	7 %	17 %	
wide range of water quality	facultative	facultative	facultative	
	caddisfly	caddisfly	scud	
4.	Cheumatopsyche sp.	Hydropsyche sparna	Cheumatopsyche sp.	
Tolerant = tolerant of poor	14 %	6 %	10 %	
water quality	facultative	facultative	facultative	
	caddisfly	caddisfly	caddisfly	
5.	Optioservus fastiditus	Optioservus fastiditus	Undetermined Turbellaria	
	9 %	4 %	8 %	
	intolerant	intolerant	facultative	
	beetle	beetle	flatworm	
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	25 (5)	7 (4)	40 (4)	
Trichoptera (caddisflies)	51 (4)	19 (5)	10 (1)	
Ephemeroptera (mayflies)	5 (3)	0 (0)	2 (1)	
Plecoptera (stoneflies)	0 (0)	0 (0)	0. (0)	
Coleoptera (beetles)	11 (2)	35 (3)	20 (2)	
Oligochaeta (worms)	0 (0)	0 (0)	0 (0)	
Other	0 (0)	0 (0)	8 (1)	
SPECIES RICHNESS	16	17	12	
BIOTIC INDEX	5.1	5.54	5.69	
EPT RICHNESS	7	5	2	
PERCENT MODEL AFFINITY	53	37	52	
FIELD ASSESSMENT	poor	poor	poor	
OVERALL ASSESSMENT	slightly impacted	moderately impacted	moderately impacted	

Appendix I. BIOLOGICAL METHODS FOR KICK SAMPLING

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

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

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

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

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

Appendix II. MACROINVERTEBRATE COMMUNITY PARAMETERS

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

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

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

4. Percent Model Affinity is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

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

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

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

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

Appendix III. LEVELS OF WATER QUALITY IMPACT IN STREAMS

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

1. Non-impacted

Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well-represented; the EPT value is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

2. Slightly impacted

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

3. Moderately impacted

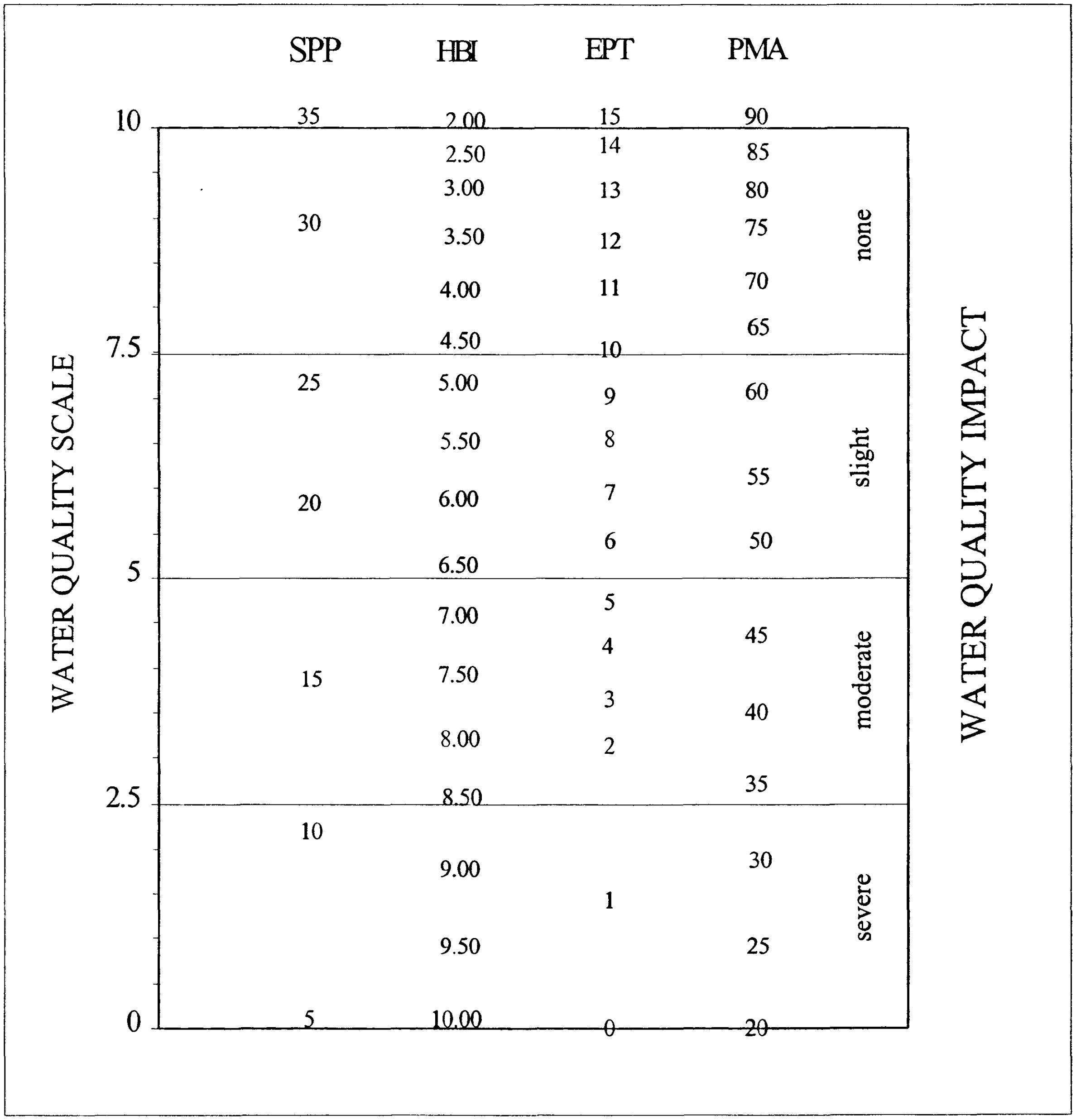
Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50.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

4. Severely impacted

Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT value is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

Appendix IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

The Biological Assessment Profile of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale as shown in the figure below.



To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices represents the assessed impact for each site.

Appendix V.
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

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

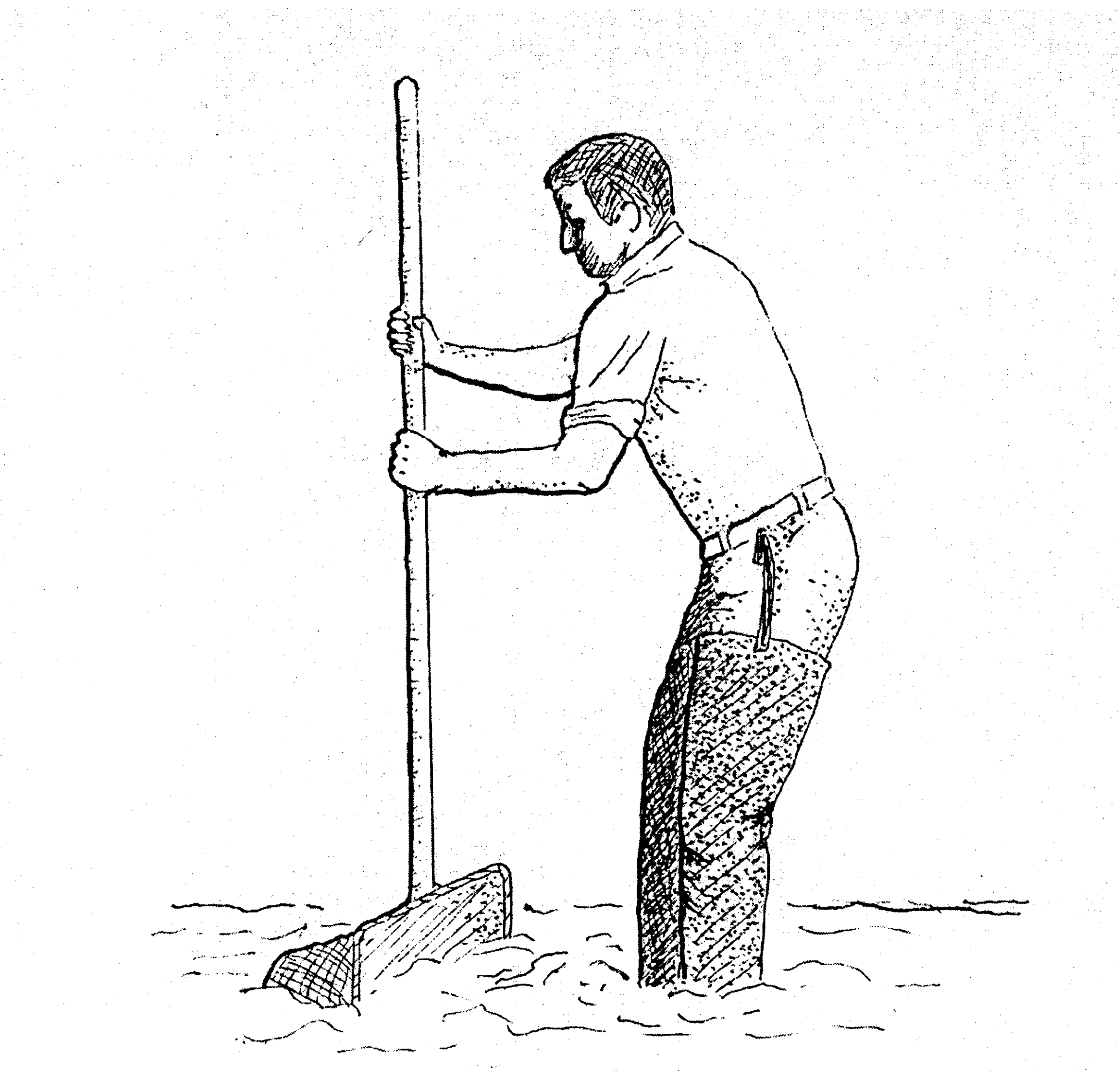
Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.
* Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA
for navigable flowing waters

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

Appendix VI.

THE TRAVELING KICK SAMPLE



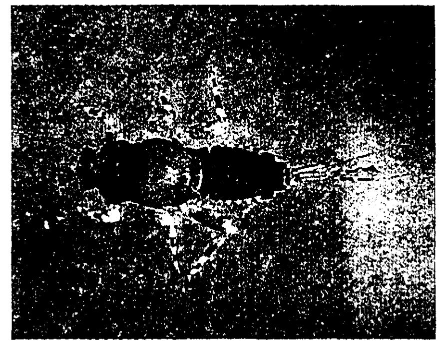
← current

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.

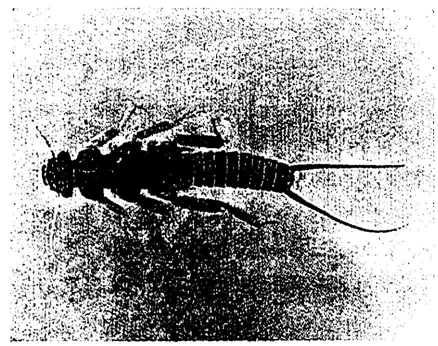
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

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.



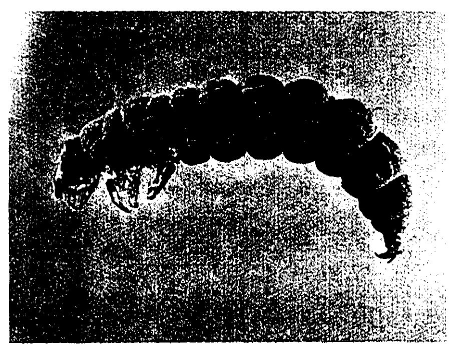
MAYFLIES

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.



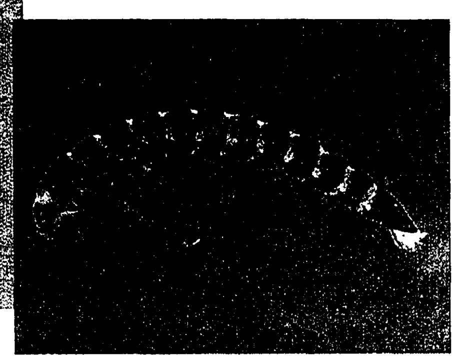
STONEFLIES

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.

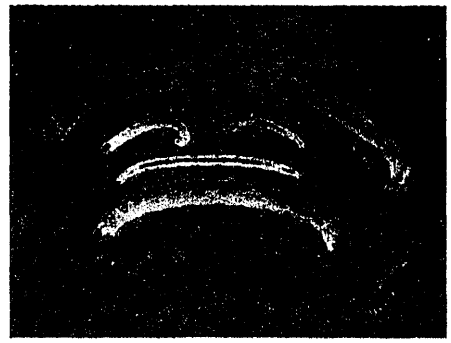


BEETLES

Appendix VII. B.

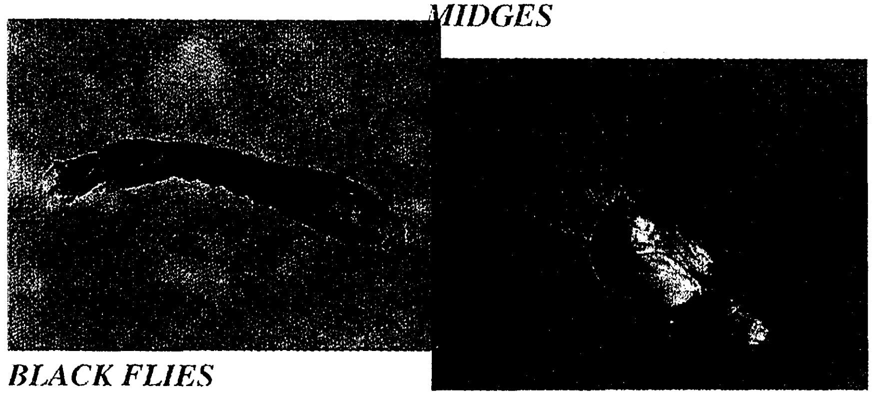
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

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.



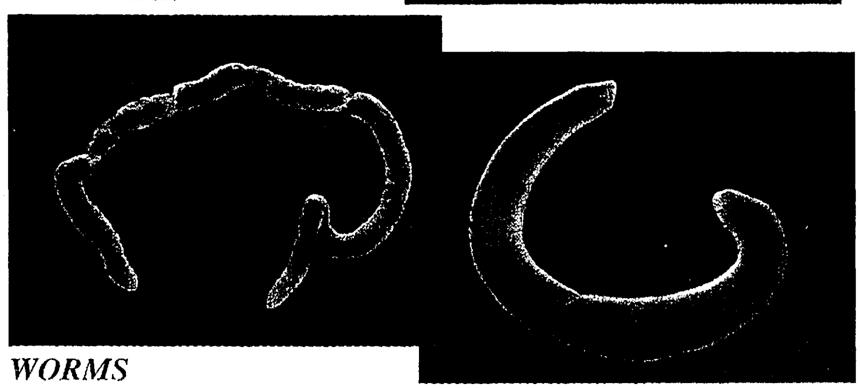
MIDGES

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.

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
<u>Isonychia</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10		15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-		-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-		-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Stenelmis</u>	5	-	-	10	5	-	5	5		10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40		10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20		20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-		-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	20	10		-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-		-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	10	-	-	5	15	-	-		5	10	-	-	-	25
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	5	10	20	-	5	10	5	5		15	10	25	10	5	10
<u>Eukiefferiella/ Tvetenia</u>	-	-	-	-	-	-	-	-		-	-	20	10	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-		-	-	-	5	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	-	-	-		-	-	-	-	-	-
<u>Polypedilum</u> (all others)	-	-	-	10	20	40	10	5		10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-		-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100		100	100	100	100	100	100

SEWAGE EFFLUENT, ANIMAL WASTES

	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
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

	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. METHODS FOR ASSESSMENT OF WATER QUALITY USING FISH

A. Sampling

Sampling in wadeable streams consists of electrofishing for approximately 40 minutes, attempting to sample one pool and one riffle. A backpack electroshocker is used; seining many also be used if appropriate. Most fish are identified and enumerated at the site and released; some specimens may be retained for later confirmation of identification.

B. Analysis of data.

Methods for interpretation of fish data with regard to water quality have not yet been standardized for northeastern streams. Four indices are used to assess water quality.

1. Species richness, weighted. Species richness is weighted by stream size using the following formula where x= richness: for stream width 1-4 meters, value= x+2; for 5-9 meters, x; for 10-19 meters, x-2; for >20 meters; x-4. Maximum value= 10.
2. Percent Non-tolerant Individuals. This is the percentage of the total individuals that are species considered intolerant or intermediate to environmental perturbations; this measure is the inverse of percent tolerant individuals. Tolerance is based on listing in EPA's Rapid Bioassessment Protocols (Plafkin et al., 1989) with the exception of Blacknose Dace, which are here considered intermediate rather than tolerant.
3. Percent Non-tolerant Species. Similar to Percent Non-tolerant Individuals, but calculated for species.
4. Percent Model Affinity, by trophic class. This is the highest percentage similarity to any of five models of non-impacted fish communities, by trophic class, as listed in Halliwell et al. (1999). The models are:

	A	B	C	D	E
Top carnivores	80	50	40	10	10
Insectivores	10	30	20	20	50
Blacknose dace	-	10	20	50	10
Generalist feeders	10	10	20	20	20
Herbivores	-	-	-	-	10

The overall assessment of water quality is assigned by the profile value. This value = (weighted richness value + 0.1[% non-tolerant individuals] +0.1[non-tolerant species] + 0.1[Percent model affinity]) /4. For assessments of streams in western New York State, a correction factor of 0.75 is applied, to offset the increased diversity that these streams exhibit compared to streams in central and eastern New York.

Halliwell, D.B., R.W. Langdon, R.A. Daniels, J.P. Kurtenbach, and R.A. Jacobson. 1999. Classification of freshwater fish species of the Northeastern United States for use in the development of indices of biological integrity, with regional applications. Chapter 12 In: Simon, T.P., ed. Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press, Inc. 671 pages.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. U.S. EPA Office of Water.

APPENDIX XII. EFFECTS OF LAKE OUTLETS AND IMPOUNDMENTS ON AQUATIC INVERTEBRATE COMMUNITIES

Lakes, ponds, and impoundments have pronounced effects on the invertebrate faunas of their outflows. Although each outflow is dependent on the characteristics of the lake, most outflows share the following traits:

1. Species richness is nearly always lower below lake outlets. Due primarily to the lack of upstream communities to provide a resource for colonization and drift, lake outlet communities often have only about 60% of the number of species found in comparable non-impacted segments. EPT richness is often only 30% of that found at non-impacted sites. Biotic index values and percent model affinity values are also depressed (see below).

2. Several types of invertebrate communities are found downstream of impoundments. Invertebrates which are commonly numerous below lake outlets include Simulium (black fly larvae), Cheumatopsyche or Hydropsyche (filter-feeding caddisflies), Nais (worms), Gammarus (crustacean), Rheotanytarsus (midges), Stenelmis (riffle beetles) Sphaerium (fingernail clams), or Platyhelminthes (flatworms). To date, 8 community types have been identified from streams in New York State.

3. A marked succession of species often occurs over a short distance. Productivity may be initially high below the lake, but usually decreases a short distance downstream. Plankton carried downstream from the lake increases the biomass immediately downstream, primarily of organisms which feed by filtering plankton, such as certain caddisflies, black flies, and midges. This enriching effect does not persist very far downstream, as the plankton is diminished, and communities below this may have very low productivity.

4. Lakes with cold-water hypolimnion releases limit the fauna additionally by interference with life cycles of aquatic insects such as mayflies, stoneflies, and caddisflies. Because the temperature of hypolimnetic releases is usually very cold, the downstream communities are often limited to midges, worms, black flies, snails, and sowbugs.

5. Water quality assessments of impoundment-affected sites usually indicate slight or moderate impact. Of 25 lake-affected stream sites across New York State, the following index means and ranges were obtained: species richness: 17 (7-24); EPT richness: 4 (0-12); Hilsenhoff biotic index: 5.83 (4.48-8.22); Percent Model Affinity: 45 (24-67). Correct interpretation of these assessments should reflect that although the resident fauna is affected, the impact is usually not a pollutional impairment. However, faunal effects caused by hypolimnion releases should be considered temperature-related and anthropogenic.

6. Corrective action for data judged to be affected by lake outlets is the adjustment of the water quality assessment up one category (e.g., slightly impacted to non-impacted) to reflect genuine water quality.

APPENDIX XIII. 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.