BIOLOGICAL STREAM ASSESSMENT

Tioughnioga River
Cortland and Broome Counties, New York

Survey date: June 11, 1992
Report date: June 26, 1992

Robert W. Bode
Margaret A. Novak
Lawrence E. Abele

Stream Biomonitoring Unit
Bureau of Monitoring and Assessment
Division of Water
NYS Department of Environmental Conservation
Albany, New York

TABLE OF CONTENTS

Stream: Tioughnioga River, Cortland and Broome Counties, New York

Reach: Homer to Lisle, New York

Background:

Biological sampling was performed by the Stream Biomonitoring Unit on the Tioughnioga River on June 11, 1992. The purpose of this survey was to assess water quality in relation to discharges, primarily the Cortland (C) Wastewater Treatment Facility discharge. At twelve sites, traveling kick samples were taken in riffle areas, as described in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of a 100-specimen subsample. Water quality assessments were based on resident macroinvertebrates (aquatic insects, worms, mollusks, crustaceans, etc.). 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 1 provides a listing of sampling sites, and Table 2 provides a listing of all macroinvertebrate species collected in the present survey.

Results and Conclusions:

1. Significant biological impairment was indicated in the Tioughnioga River downstream of the Cortland (C) Wastewater Treatment Facility discharge. The greatest effects were found 1.8 miles downstream of the discharge, where pollution-sensitive caddisflies, stoneflies, and riffle beetles were eliminated from the benthic fauna. The effects extend downstream at least 2.9 miles from the discharge, to Blodgett Mills; recovery is indicated 5.6 miles downstream of the discharge, below Hoxie Gorge. Water quality from Hoxie Gorge to Lisle is considered non-impacted.

2. Non-impacted water quality was found in the East Branch above the confluence, and in the West Branch above and below Homer. Slight impact from unknown sources was indicated in the West Branch at the Route 13 bridge, 0.5 miles above the confluence.

3. The results of the present survey show some improvement when compared to results of a 1972 DEC macroinvertebrate survey of the Tioughnioga River. That survey concluded that effects of Cortland sewage discharges extended downstream for 12 miles, with recovery occurring at Marathon. Other conclusions of the 1972 study were similar to the present study, including non-impacted conditions in the East Branch and upper West Branch, impact in the West Branch upstream of the confluence, and non-impacted conditions at Marathon and Lisle. Impacts caused by discharges in Homer, indicated in the 1972 study, were not detected in the present study.

Discussion:

During the present survey of the Tioughnioga River, a substantial decline in the macroinvertebrate fauna was observed below the Cortland WWTF discharge (Station 9) compared to the upstream site (Station 8a). Because of this, replicate kick samples were taken at the upstream and downstream sites, for possible implementation of the biological impairment criteria procedures (Bode et al, 1990). Laboratory analysis of the single kick samples from these sites showed a probable impairment, and the biological impairment criteria procedures were then implemented.

Based on replicate kick sample analysis above and below the Cortland WWTF, a significant biological impairment criteria occurs. Exceedances of criteria occurred in four of the five criteria (Table 3), and all were found to be significant. A significant exceedance of any one of the five criteria is the basis for concluding that a significant biological impairment is present. The site descriptions of the upstream and downstream sites (Table 4) show that habitat comparability between the sites is acceptable.

At the first site downstream of the Cortland WWTF discharge, a substantial faunal difference was evident between the east and west sides of the river, and samples were collected on both sides to document this. The east side of the river (Station 9E) had a fauna similar to that upstream of the discharge, while the west side (Station 9W) had a much poorer fauna. The west side fauna had fewer mayflies and caddisflies, and had no riffle beetles; tolerant worms were the dominant benthic organism. The difference between the two sides is mostly attributed to incomplete lateral mixing of effluent which enters on the west side. Some slight east/west differences above the discharge were due to different contributions of the East and West Branches, but these are not seen as responsible for the substantial faunal differences documented downstream of the WWTF discharge. The difference between the two sides at the downstream site was similarly observed by Cooper and Neuderfer (1973).

At the Hoxie Gorge site, 5.7 miles below the Cortland WWTF discharge, the macroinvertebrate fauna indicated that the river had recovered from the effects of the discharge. The EPT level had been restored to the level found above the discharge, and all major groups were represented.

The impact observed in the present survey is not typical of that usually found downstream of sewage discharges. The 3-mile impact zone is considered short for sewage discharges; a more typical 12-mile zone was observed in the Tioughnioga River below Cortland in the 1972 survey (Cooper and Neuderfer, 1973). The lower reach of a recovery zone is typically dominated by filter-feeding caddisflies, which were sparse in the present survey, but numerous in the 1972 survey. These caddisflies are very sensitive to chlorine, and their absence in the impact zone may indicate occasional high chlorine levels. A 3-mile zone of chlorine impact,

however, would be considered long compared to most sampled. Although the above projections have not been confirmed with chemical measurements, it seems clear that the reach downstream of the sewage discharge is not typical of most sampled.

During 1991 sampling for the Rotating Intensive Basin Studies, macroinvertebrate sampling was conducted in September, 1991, at two Tioghnioga River sites, Cortland at Port Watson Avenue (TOGH-8a), and Blodgett Mills (TOGH-9). The index values from these samples are compared to those from the present survey in Table 5. These results show good consistency between the two years. Although some individual index values differ, reflecting seasonal faunal changes, the overall O'Brien Scores (0-10 scale) compare well, indicating non-impacted water quality at the Cortland site and slightly impacted water quality at the Blodgett Mills site for both years.

A previous macroinvertebrate survey of the Tioughnioga River was performed by the NYS Department of Environmental Conservation in 1972 (Cooper and Neuderfer, 1973). The conclusions of that study were: 1) "water quality in the West Branch Tioughnioga River above Homer was very good"; "wastes which were entering the stream in Homer were degrading the stream noticeably"; 2) "water quality in the East Branch was good before confluence with the West Branch"; 3) "inadequately treated sewage from the City of Cortland resulted in considerable degradation of the Tioughnioga River which extended downstream for about 12 miles before complete recovery occurred" [recovery occurred at Marathon]; 4) "the study did not indicate any effects from wastes discharged at Marathon or Whitney Point".

Comparing point-by-point conclusions with the 1972 study, 1) both studies found excellent water quality above Homer; the present study found impact downstream of Homer, while the 1972 study attributed the impact to Homer; 2) both studies found non-impacted conditions in the East Branch above the confluence; 3) the present study documented degradation from Cortland sewage discharges for approximately 3 miles downstream, compared to 12 miles in the 1972 study; this indicates an improvement; 4) both studies found non-impacted conditions at Marathon and Lisle.

Literature cited

Bode, R.W., M.A. Novak, and L.E. Abele. 1990. Biological impairment criteria for flowing waters in New York State. NYS DEC technical report, 110 pages.

Cooper, A.L., and G.N. Neuderfer. 1973. A macroinvertebrate study of Tioughnioga River. NYS DEC, Division of Fish and Wildlife, Avon Pollution Investigations. 25 pages + 8 pages maps.

TABLE 1. Station locations for the Tioughnioga River, Cortland and Broome Counties.

STATION	LOCATION
01	above Homer - West Branch 100 m below Rt. 11 bridge
02	below Homer - West Branch 15 m below Miller St. bridge
04	Cortland - West Branch 5 m below Rt. 13 bridge
08	Cortland - East Branch at Rt. 12 and Rt. 81 overpasses
08A	Cortland 40 m above Port Watson Ave. bridge
09	below Cortland at RR bridge
11	below Cortland off Loop Rd.
12	Blodgett Mills 50 m above Blodgett Mills bridge
14	below confluence with Hoxie Gorge Hoxie Gorge parking area off Rt. 11
15	Messengerville opposite Gridley Creek
16	Marathon at head of island above Rt. 221 bridge
17	Lisle 100 m below Rt. 79 bridge

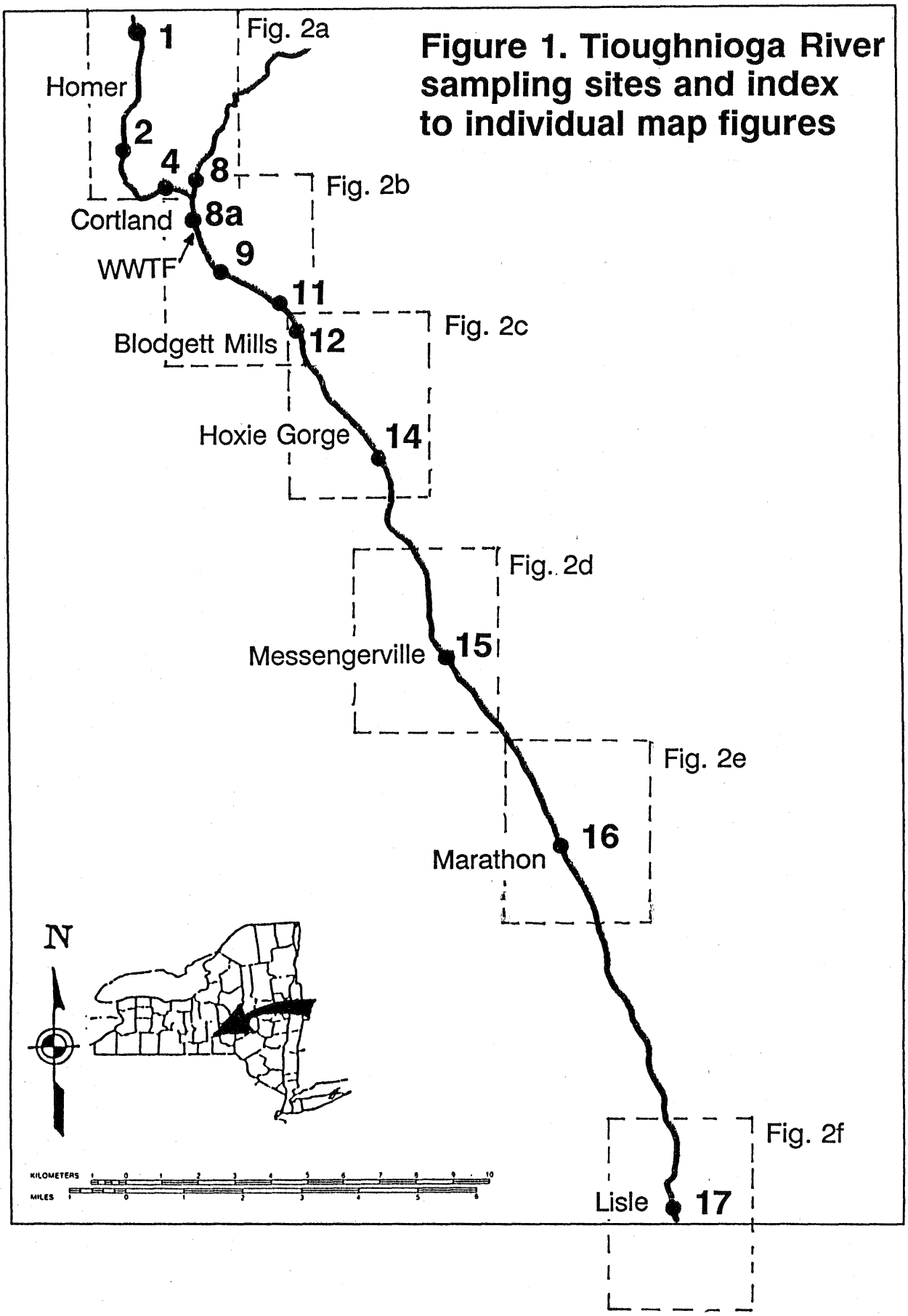


Figure 2a	Site location map	Tioughnioga River

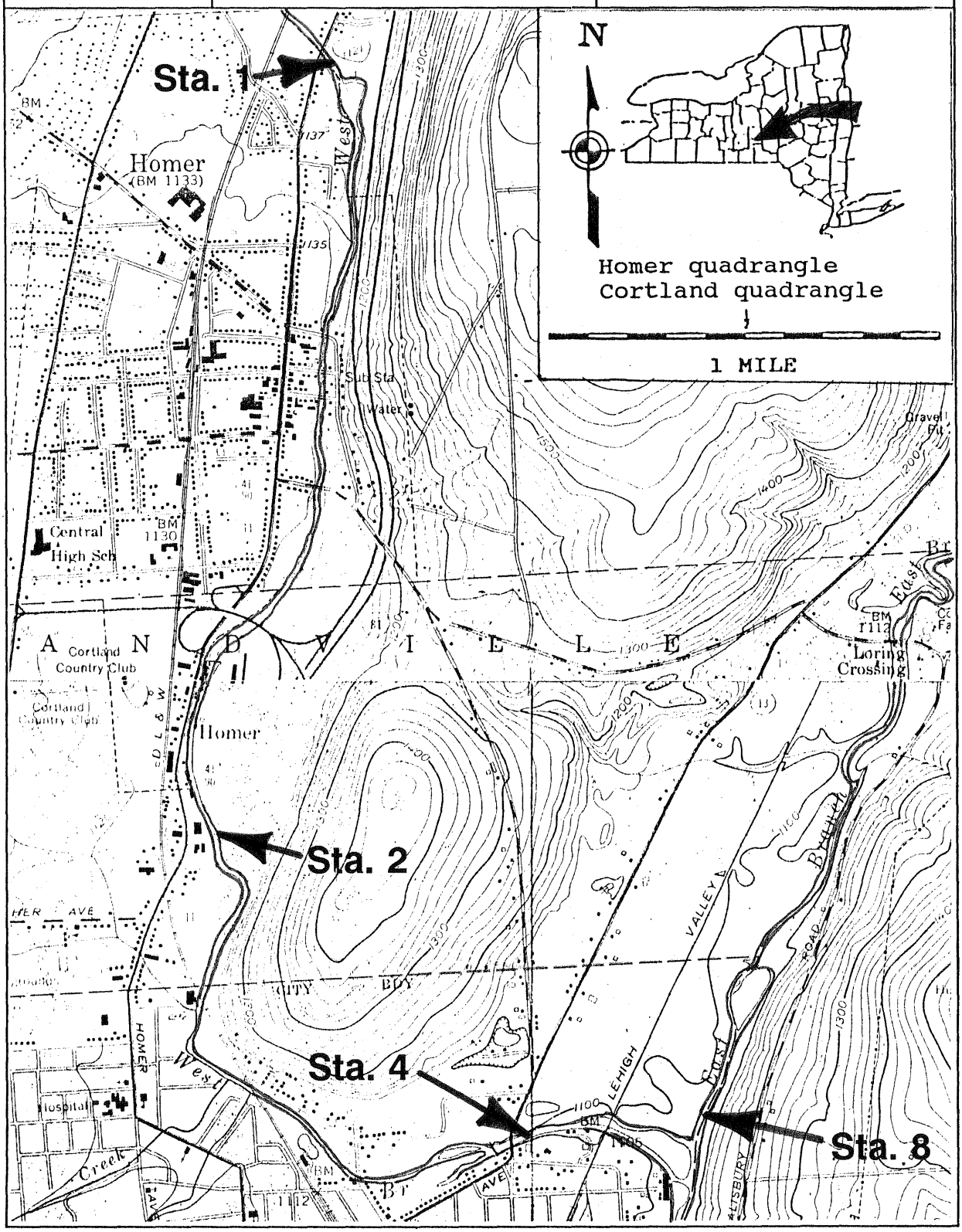


Figure 2b	Site location map	Tioughnioga River

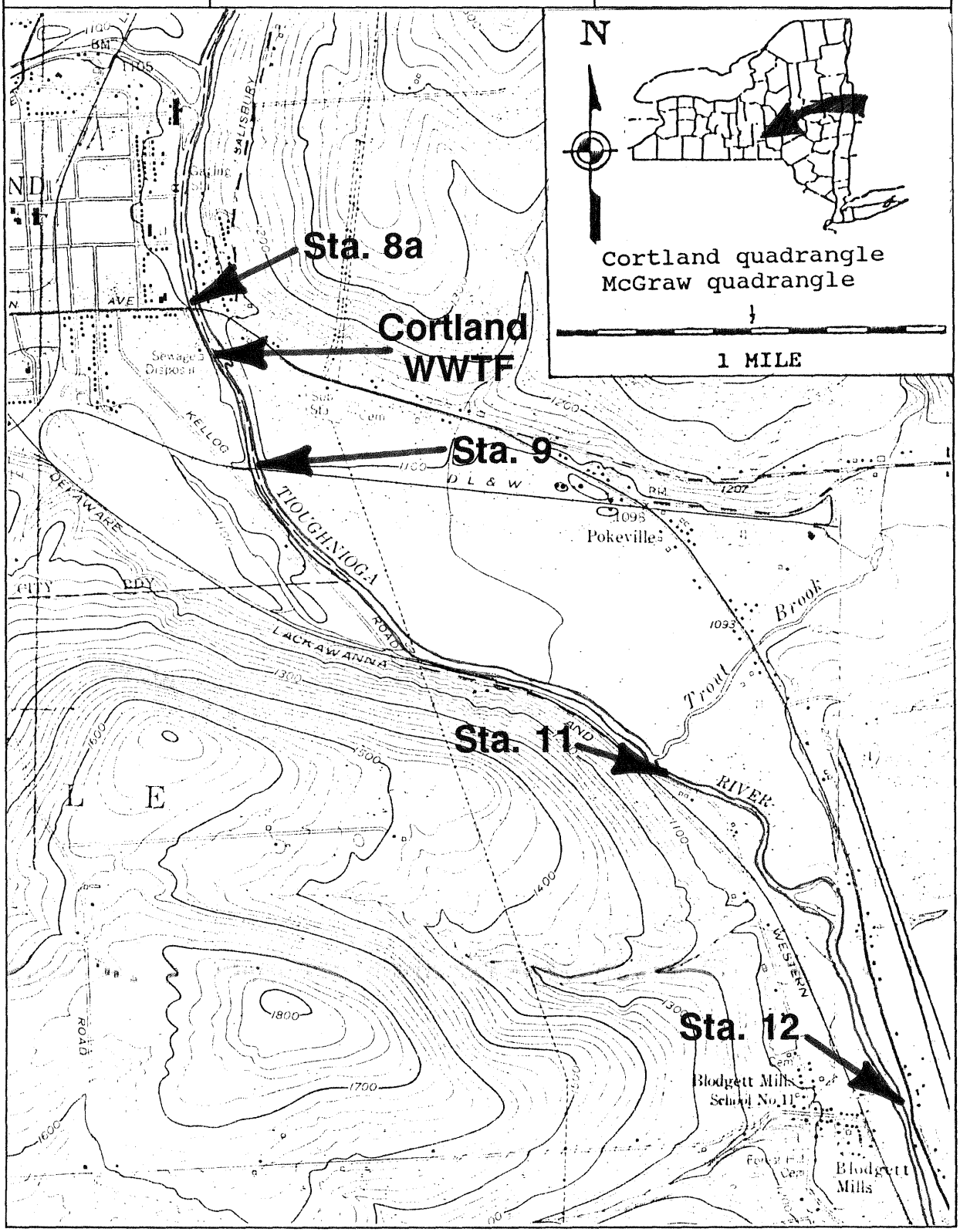


Figure 2f	Site location map	Tioughnioga River

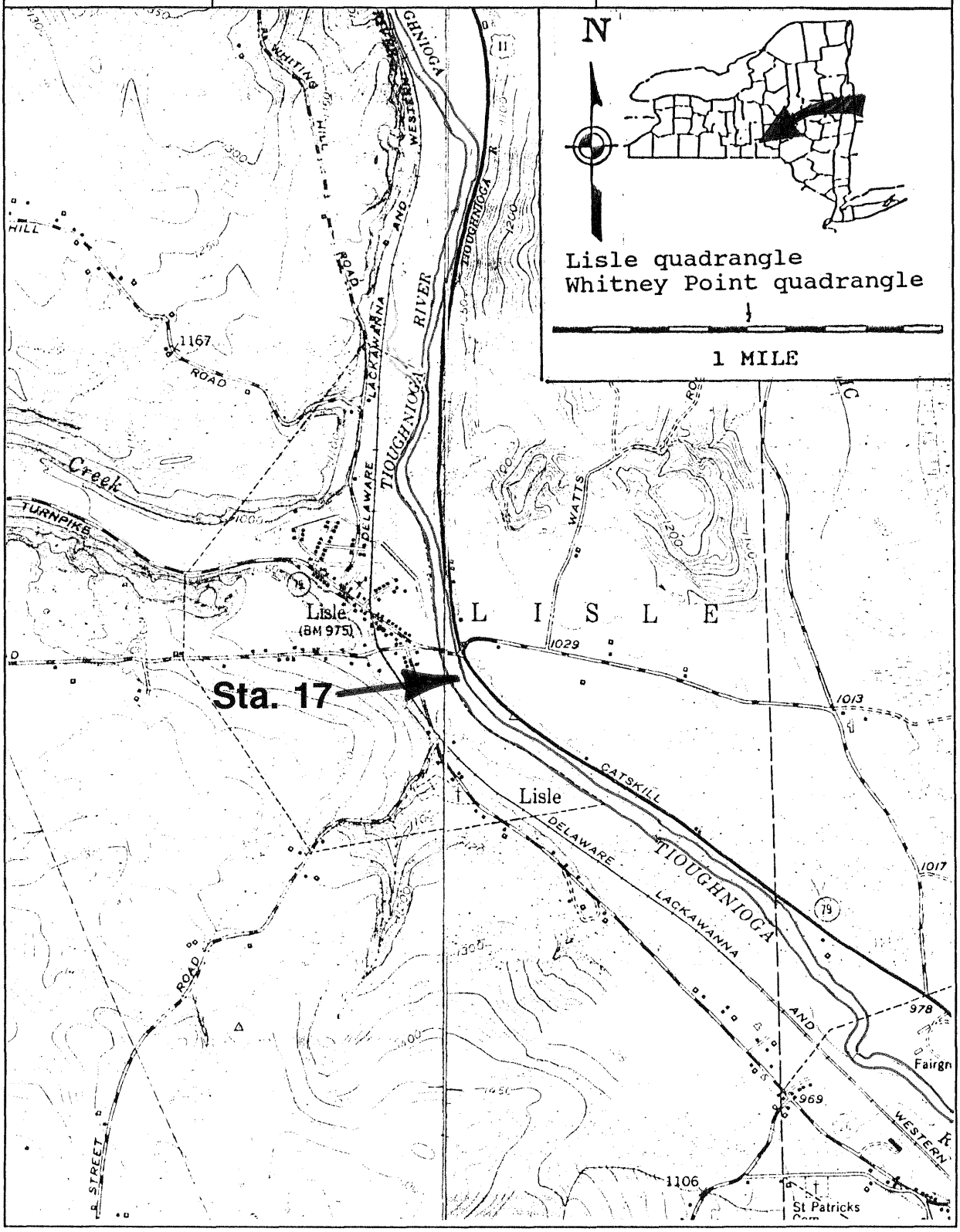


Figure 2c	Site location map	Tioughnioga River

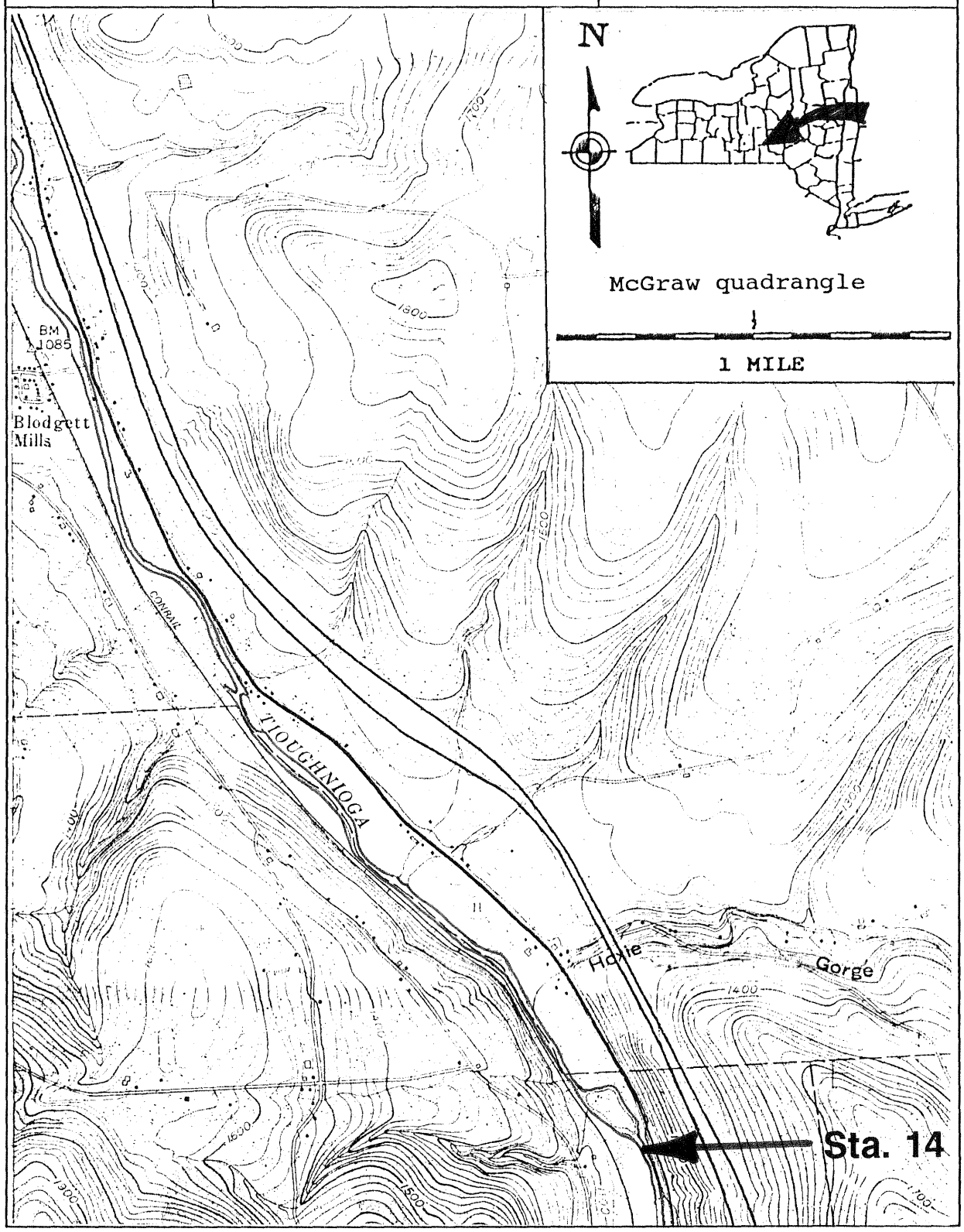


Figure 2d	Site location map	Tioughnioga River

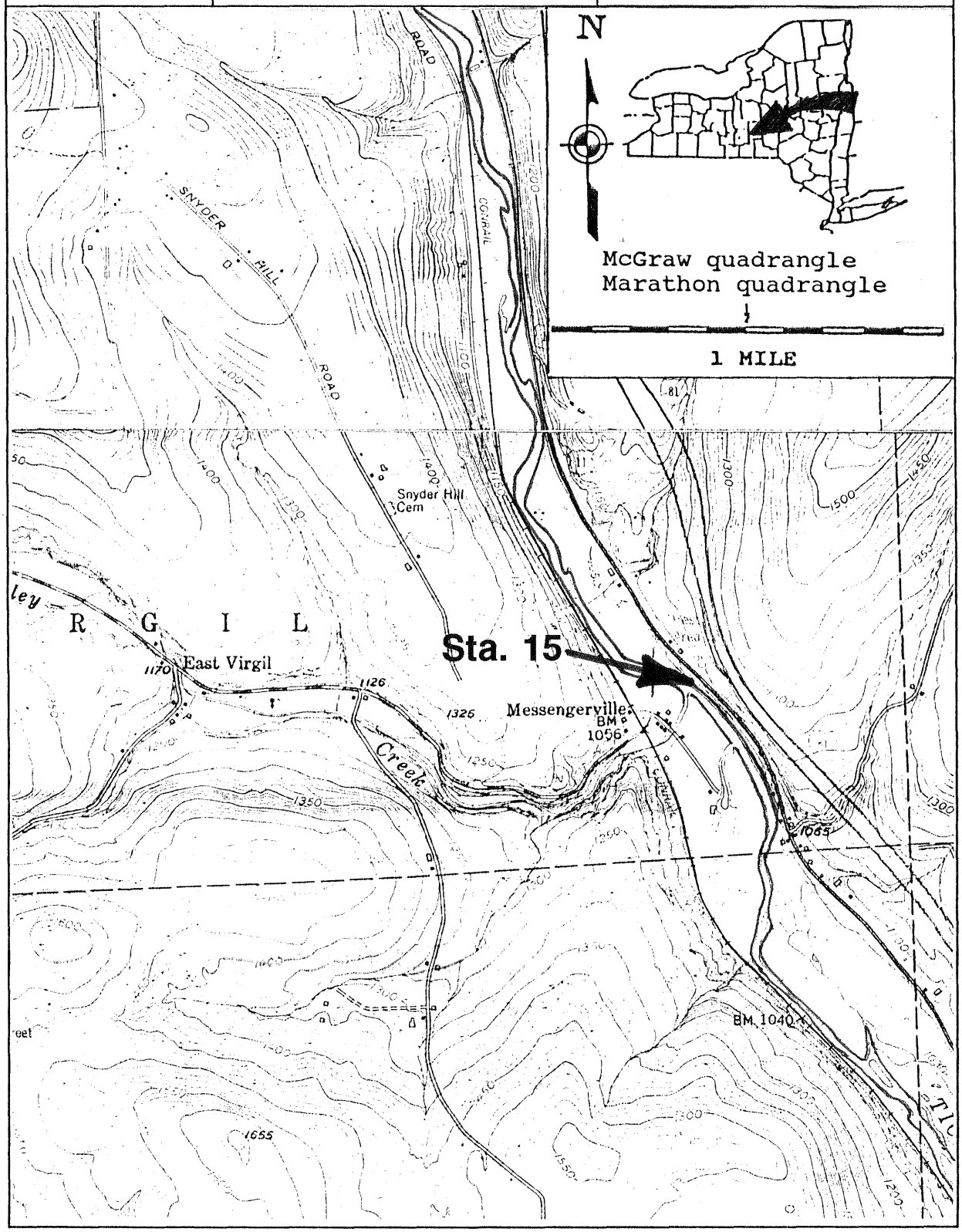


Figure 2e	Site location map	Tioughnioga River

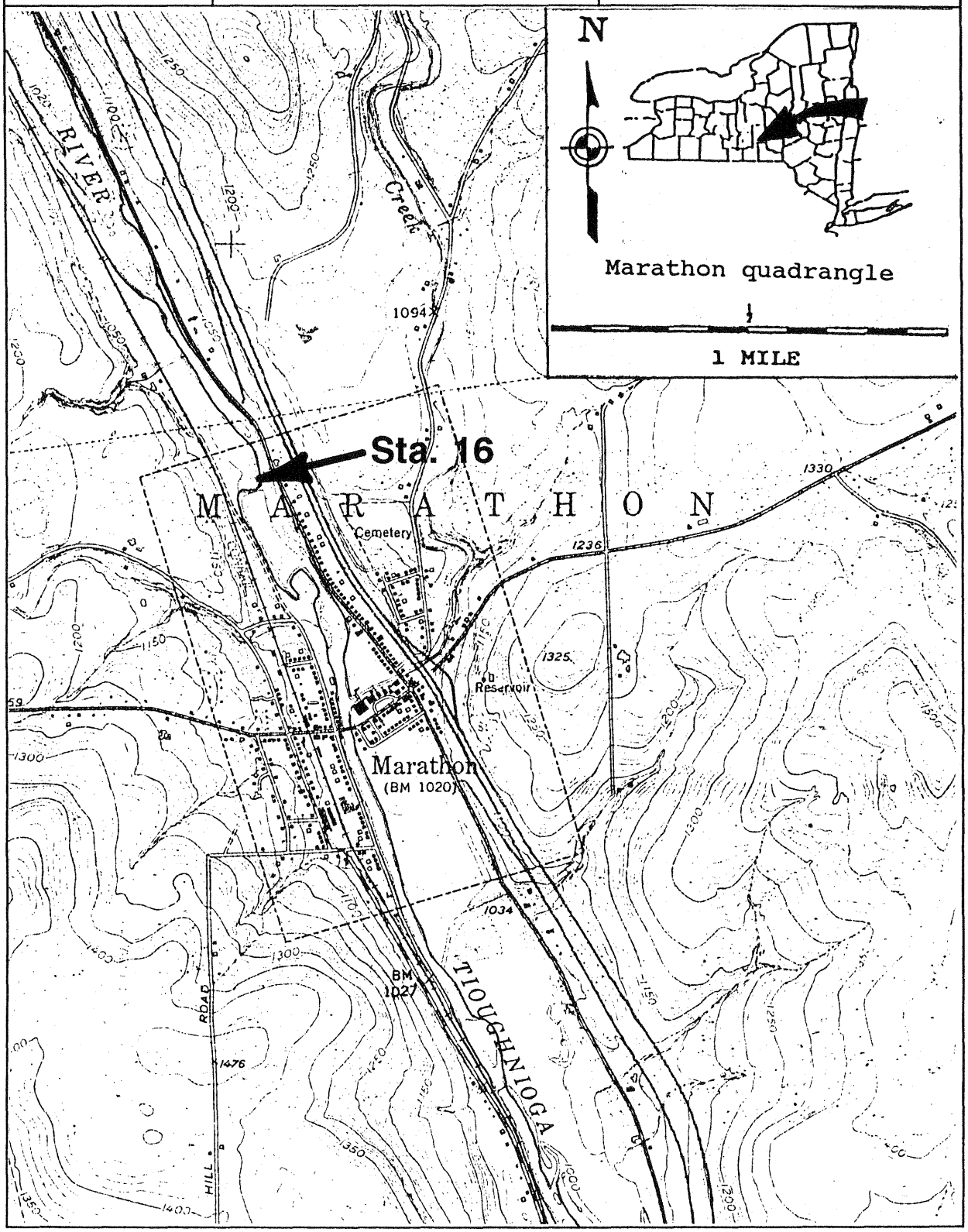


Figure 3. O'Brien Plot of index values, Tioughnioga River, 1992.
SPP= species richness, EPT= EPT value, HBI= Hilsenhoff Biotic Index, PMA= Percent Model Affinity. Values are plotted on a corrected scale of water quality. The line connects the mean of the four values for each site. See Appendix IV for more complete explanation.

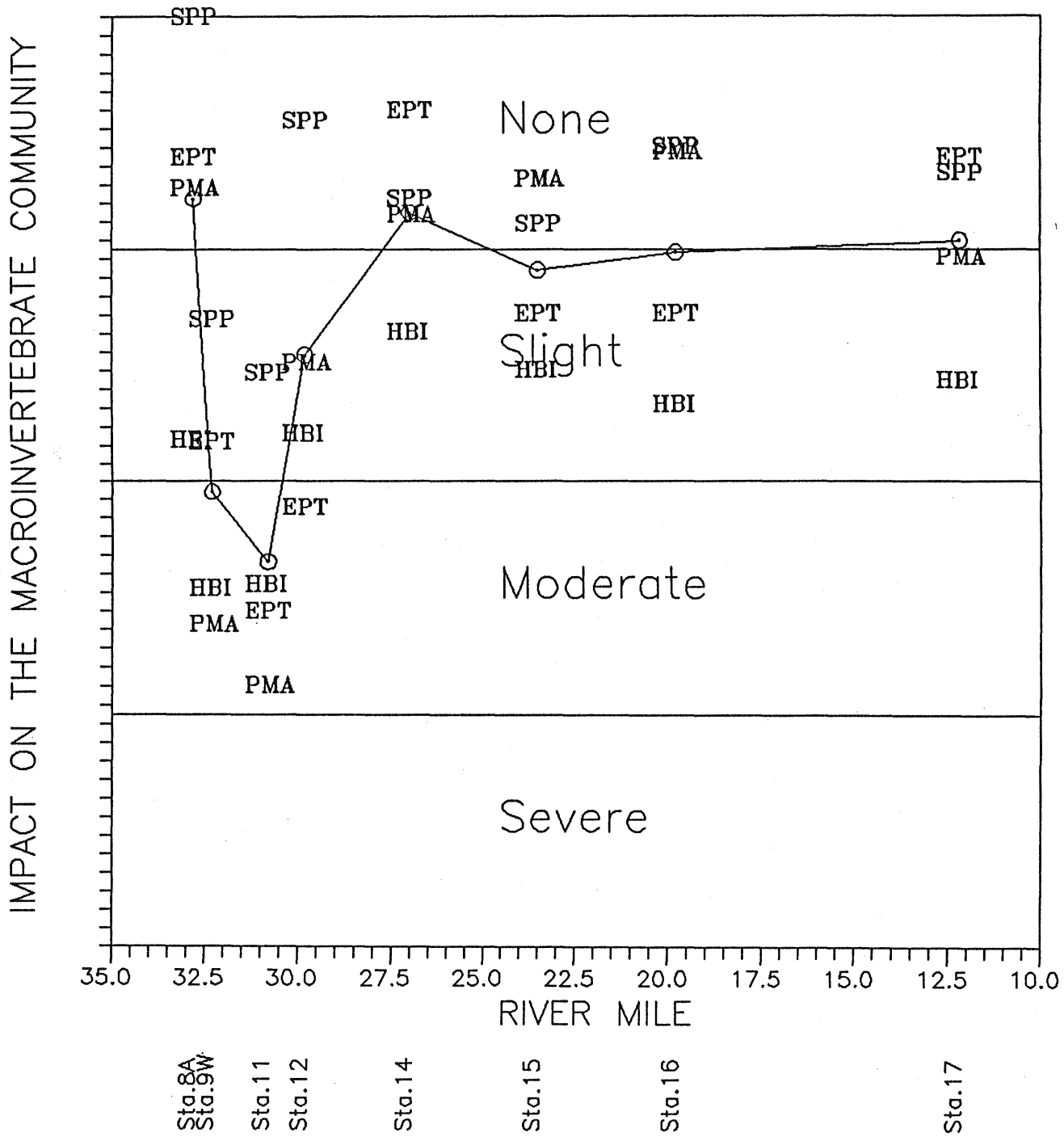


TABLE 2. MACROINVERTEBRATE SPECIES COLLECTED IN THE TIOUGHNIOGA RIVER, CORTLAND AND BROOME COUNTIES, JUNE 11, 1992.

NEMERTEA
- Prostoma graecense (=rubrum)

PLATYHELMINTHES
- TURBELLARIA
  - Undetermined Turbellaria

ANNELIDA
- OLIGOCHAETA
  - Undetermined Lumbricina
  - Enchytraeidae
    - Undetermined Enchytraeidae
  - Tubificidae
    - Aulodrilus piqueti
    - Limnodrilus hoffmeisteri
    - Undet. Tubificidae w/ cap. setae
    - Undet. Tubificidae w/o cap. setae
  - Naididae
    - Nais barbata
    - Nais behningi
    - Nais bretscheri
    - Nais elinguis
    - Nais pardalis
    - Nais simplex
    - Nais variabilis
    - Ophidonais serpentina
    - Slavina appendiculata
- HIRUDINEA
  - Undetermined Hirudinea

MOLLUSCA
- GASTROPODA
  - Ancylidae
    - Ferrissia rivularis
  - Hydrobiidae
    - Undetermined Hydrobiidae
- PELECYPODA
  - Sphaeriidae
    - Pisidium sp.

ARTHROPODA
- CRUSTACEA
  - ISOPODA
    - Asellidae
      - Caecidotea sp.
  - DECAPODA
    - Cambaridae
      - Undetermined Cambaridae
- INSECTA
  - EPHEMEROPTERA
    - Baetidae
      - Acentrella sp.
      - Baetis brunneicolor
      - Baetis flavistriga
      - Baetis intercalaris
      - Baetis sp.
    - Heptageniidae
      - Leucrocuta sp.
      - Stenacron interpunctatum
      - Stenonema terminatum
      - Stenonema vicarium
      - Stenonema sp.
      - Undetermined Heptageniidae
    - Leptophlebiidae
      - Paraleptophlebia mollis
    - Ephemerellidae
      - Drunella cornutella
      - Ephemerella dorothea
      - Ephemerella needhami
      - Ephemerella rotunda
      - Eurylophella sp.
      - Serratella deficiens
      - Serratella sp.
    - Tricorythidae
      - Tricorythodes sp.
    - Caenidae
      - Caenis latipennis
      - Caenis sp.
    - Potamanthidae
      - Anthopotamus sp.
    - Ephemeridae
      - Ephemera sp.
  - ODONATA
    - Coenagrionidae
      - Argia sp.
      - Undetermined Coenagrionidae
  - PLECOPTERA
    - Leuctridae
      - Undetermined Leuctridae
    - Perlidae
      - Neoperla sp.
      - Perlesta placida
  - COLEOPTERA
    - Hydrophilidae
      - Berosus sp.
    - Psephenidae
      - Psephenus sp.
    - Elmidae
      - Dubiraphia quadrinotata
      - Dubiraphia vittata
      - Dubiraphia sp.
      - Optioservus fastiditus
      - Optioservus trivittatus
      - Optioservus sp.
      - Stenelmis crenata
      - Stenelmis sp.
  - TRICHOPTERA
    - Philopotamidae
      - Chimarra obscura?
      - Dolophilodes sp.
    - Psychomyiidae
      - Psychomyia flavida
    - Polycentropodidae
      - Polycentropus sp.
    - Hydropsychidae
      - Cheumatopsyche sp.
      - Hydropsyche bronta
      - Hydropsyche leonardi
      - Hydropsyche scalaris
      - Hydropsyche sparna
    - Rhyacophilidae
      - Rhyacophila fuscula

TABLE 2 (continued). MACROINVERTEBRATE SPECIES COLLECTED IN THE TIOUGHNIOGA RIVER, CORTLAND AND BROOME COUNTIES, JUNE 11, 1992.

- Hydroptilidae
  - Hydroptila sp.
- Brachycentridae
  - Brachycentrus lateralis
- Helicopsychidae
  - Helicopsyche borealis
- Leptoceridae
  - Ceraclea punctata
  - Ceraclea sp.
  - Mystacides sp.
  - Oecetis avara
  - Oecetis sp.

LEPIDOPTERA
- Pyralidae
  - Petrophila sp.
  - Undetermined Lepidoptera

DIPTERA
- Tipulidae
  - Antocha sp.
- Ceratopogonidae
  - Undetermined Ceratopogonidae
- Simuliidae
  - Simulium jenningsi
  - Simulium vittatum
- Empididae
  - Hemerodromia sp.
- Chironomidae
  - Tanypodinae
    - Telopelopia okoboji
    - Thienemannimyia gr. spp.
  - Diamesinae
    - Diamesa spp.
    - Pagastia sp. A
    - Potthastia gaedii
  - Orthocladiinae
    - Cardiocladius obscurus
    - Cricotopus bicinctus
    - Cricotopus tremulus gr.
    - Cricotopus trifascia gr.
    - Eukiefferiella brevicalcar gr.
    - Nanocladius minimus
    - Nanocladius spiniplenus
    - Orthocladius annectens
    - Orthocladius nr. dentifer
    - Orthocladius obumbratus
    - Parametriocnemus lundbecki
    - Tvetenia bavarica gr.
    - Tvetenia vitracies
  - Chironominae
    - Chironomini
      - Cryptochironomus fulvus gr.
      - Dicrotendipes neomodestus
      - Phaenopsectra dyari?
      - Polypedilum aviceps
      - Polypedilum convictum
      - Polypedilum scalaenum gr.
    - Tanytarsini
      - Cladotanytarsus nr. mancus
      - Cladotanytarsus sp. 4
      - Micropsectra polita?
      - Paratanytarsus confusus
      - Paratanytarsus dimorphis
      - Rheotanytarsus exiguus gr.
      - Sublettea coffmani
      - Tanytarsus guerlus gr.

Table 3. ASSESSMENT USING BIOLOGICAL IMPAIRMENT CRITERIA.

Location/date

UPSTREAM: Tioughnioga River, above Cortland WWTF, 11 June 1992

DOWNSTREAM: Tioughnioga River, below Cortland WWTF, 11 June 1992

	Percent similarity between replicates (minimum acceptable value 50%)
UPSTREAM	
Replicate A/Replicate B	67
Replicate A/Replicate C	56
Replicate B/Replicate C	70
DOWNSTREAM	
Replicate A/Replicate B	65
Replicate A/Replicate C	71
Replicate B/Replicate C	73

	Species Richness	EPT Value	Biotic Index	Species Dominance	Model Affinity
UPSTREAM					
Replicate A	31	7	6.79	31	59
Replicate B	23	8	5.73	23	74
Replicate C	29	9	5.52	29	76
MEAN	28	8	6.01	28	70
DOWNSTREAM					
Replicate A	18	2	8.16	32	32
Replicate B	21	3	7.39	28	28
Replicate C	16	2	7.84	27	27
MEAN	18	2	7.80	29	29
NET CHANGE	-10	-6	+1.79	+1	-41
CRITERIA	-8	-4	+1.50	+15	-20
EXCEEDANCE?	Y	Y	Y	N	Y
t value at p <.05 (min = 2.78)	3.55	8.95	4.07	-	7.33
SIGNIFICANT IMPAIRMENT?	Y	Y	Y	N	Y

Table 4. HABITAT MEASUREMENTS FOR IMPAIRMENT TESTING.

UPSTREAM	TOGH-8a
Location	Tioughnioga River in Cortland, New York, 40 meters upstream of Port Watson Avenue bridge, approximately in midstream.
Substrate	Mean particle size -1.6 (Phi scale)
Embeddedness	50%
Current Speed	67 cm/sec
Canopy Cover	5%
DOWNSTREAM	TOGH-9
Location	Tioughnioga River, Cortland, New York, at Railroad bridge at Kellog Road, approximately 0.4 miles downstream of Cortland (C) WWTF, on west side of river.
Substrate	Mean particle size -2.1 (Phi scale)
Embeddedness	50%
Current speed	100 cm/sec
Canopy Cover	10%

HABITAT COMPARABILITY BETWEEN SITES ACCEPTABLE? (Y or N): Y

Table 5. Comparison of 1991 vs. 1992 results

	Species Richness	EPT Value	Biotic Index	Model Affinity	O'Brien Score
Cortland, Port Watson Ave. (TOGH-8a)					
1991	28	14	4.32	64	8.1
1992	37	12	6.12	71	8.1
Blodgett Mills (TOGH-12)					
1991	27	4	5.58	52	5.9
1992	31	5	6.08	57	6.3

Description of sites sampled:

On the date of sampling, June 11, 1992, the Tioughnioga River at the sites sampled was 8-80 meters wide, 0.2-0.7 meters deep, and had current speeds of 67-143 cm/sec in riffles. Dissolved oxygen was 8.5-10.9 mg/l, specific conductance was 275-653 μmhos, pH was 7.9-8.7, and the temperature was 11.6-21.3 °C. Measurements for each site are found on the field data summary sheets.

Station 1. This site was located on the West Branch just east of Route 11, at the north end of Homer. A long, shallow riffle was sampled, and was found to have a high diversity of clean-water macroinvertebrates. Mayflies, stoneflies, and caddisflies were well-represented in the kick sample, and the site was field-assessed as non-impacted. Based on the four parameter values, overall water quality is assessed as non-impacted.

Species richness: 30 (excellent)
Biotic index: 3.53 (excellent)
EPT value: 14 (excellent)
Percent Model Affinity: 78% (excellent)
Dominant species:
Optioservus fastiditus (intolerant beetle) 19%
Psephenus sp. (facultative beetle) 9%
Paraleptophlebia mollis (intolerant mayfly) 9%
Water Quality Assessment: non-impacted

Station 2. A sample was taken on the West Branch below the Miller Street bridge, at the south end of Homer. Water temperature here was 16.8° C, compared to 11.6° C upstream at Station 1. This temperature increase was also found just 0.7 miles below Station 1, and is likely caused by the widened stream section at Durkee Memorial Park. The dissolved oxygen level had decreased from 9.3 to 8.5 ppm. Although many species had changed from the upstream site, mayflies, stoneflies, and caddisflies were still represented, and overall water quality was indicated to be non-impacted, as at Station 1.

Species richness: 37 (excellent)
Biotic index: 5.07 (good)
EPT value: 15 (excellent)
Percent Model Affinity: 78% (excellent)
Dominant species:
Stenonema terminatum (intolerant mayfly) 13%
Undetermined Turbellaria (facultative flatworm) 8%
Cricotopus trifascia gr. (facultative midge) 6%
Water Quality Assessment: non-impacted

Station 4. This West Branch site was located at Route 13 in Cortland, 0.5 miles upstream of the confluence with the East Branch. The kick sample was taken directly below the bridge. Conditions appeared enriched compared to Station 2 below Homer, with more filamentous algae and diatoms, and higher contribution of oligochaete worms. Based on the four parameters, water quality was assessed as slightly impacted.

Species richness: 30 (excellent)
Biotic index: 5.43 (good)
EPT value: 5 (fair)
Percent Model Affinity: 61% (good)
Dominant species:
Nais bretscheri (facultative worm) 17%
Cricotopus trifascia gr. (facultative midge) 11%
Tricorythodes sp. (facultative mayfly) 7%
Serratella deficiens (intolerant mayfly) 7%
Water Quality Assessment: slightly impacted

Station 8. The site was located on the East Branch at Yaman Park, about 0.1 miles upstream of the confluence with the West Branch. The stream was high and muddy from heavy rains five days prior to sampling. The macroinvertebrate fauna included a good diversity of organisms, and water quality was field-assessed as non- to slightly impacted. All four parameter values were in the range of non-impacted water quality.

Species richness: 38 (excellent)
Biotic index: 4.24 (excellent)
EPT value: 19 (excellent)
Percent Model Affinity: 80% (excellent)
Dominant species:
Oecetis avara (facultative caddisfly) 8%
Brachycentrus lateralis (intolerant caddisfly) 7%
Optioservus trivittatus (intolerant riffle beetle) 7%
Water Quality Assessment: non-impacted

Station 8A. This site was on the main stem Tioughnioga River at Port Watson Avenue, 0.5 miles below the confluence of the East and West Branches. The west side of the river was much clearer than the east side, reflecting the differences between the two branches. The sample taken approximately in midstream indicated non-impacted water quality.

Species richness: 37 (excellent)
Biotic index: 6.12 (good)
EPT value: 12 (excellent)
Percent Model Affinity: 71% (excellent)
Dominant species:
Nais bretscheri (facultative worm) 16%
Tricorythodes sp. (facultative mayfly) 12%
Caenis latipennis (facultative mayfly) 7%
Rheotanytarsus exiguus gr. (facultative midge) 7%
Water Quality Assessment: non-impacted

Station 9. Sampling was conducted at the railroad bridge about 0.4 miles downstream of the discharge of the Cortland (C) Wastewater Treatment Facility. The west side of the river exhibited higher specific conductance than the east side (653 vs. 288 μmhos), and also exhibited a much poorer fauna. The fauna of the west side was dominated by tolerant worms, indicating high levels of bacteria. Mayflies and caddisflies were present on the west side, but in low numbers; riffle beetles were absent. The west side parameter values indicated moderate impact, while the east side parameter

values indicated no impact.

East side sample:
- Species richness: 34 (excellent)
- Biotic index: 5.72 (good)
- EPT value: 13 (excellent)
- Percent Model Affinity: 70% (good)
- Dominant species:
  - Stenelmis crenata (facultative beetle) 13%
  - Limnodrilus hoffmeisteri (tolerant worm) 11%
  - Leucrocuta sp. (intolerant mayfly) 8%
- Water Quality Assessment: non-impacted

West side sample:
- Species richness: 24 (good)
- Biotic index: 7.41 (fair)
- EPT value: 6 (good)
- Percent Model Affinity: 40% (fair)
- Dominant species:
  - Nais bretscheri (facultative worm) 23%
  - Limnodrilus hoffmeisteri (tolerant worm) 19%
  - Nais variabilis (tolerant worm) 12%
- Water Quality Assessment: moderately impacted

Station 11. This site was located below Cortland off Loop Road, and was about 1.8 miles below the WWTF discharge. The macroinvertebrate fauna was poorer than at Station 9, being dominated by tolerant worms and midges. Stoneflies, caddisflies, and riffle beetles were not found. The parameter values indicated moderately impacted water quality, as at Station 9.
- Species richness: 22 (good)
- Biotic index: 7.38 (fair)
- EPT value: 3 (fair)
- Percent Model Affinity: 36% (fair)
- Dominant species:
  - Nais bretscheri (facultative worm) 30%
  - Nais variabilis (tolerant worm) 11%
  - Undet. Tubificidae w/o cap. setae (tolerant worm) 10%
- Water Quality Assessment: moderately impacted

Station 12. A sample was taken upstream of the bridge at Blodgett Mills. The benthic macroinvertebrate fauna appeared sparse; only mayflies, midges, and worms were noted in the sample. Caddisflies were not found in the sample, although beetles were found. The four parameter values indicated slightly impacted water quality.
- Species richness: 31 (excellent)
- Biotic index: 6.08 (good)
- EPT value: 5 (fair)
- Percent Model Affinity: 57% (good)
- Dominant species:
  - Cricotopus trifascia gr. (facultative midge) 16%
  - Nais bretscheri (facultative worm) 15%
  - Acentrella sp. (facultative mayfly) 9%
- Water Quality Assessment: slightly impacted

Station 14. This site was located downstream of Hoxie Gorge. The substrate and general habitat were similar to that at the Blodgett Mills site. The macroinvertebrate fauna was considered improved, with the addition of caddisflies and stoneflies, which were not found at the Blodgett Mills site. The four parameter values indicated non-impacted water quality.

Species richness: 28 (excellent)
Biotic index: 5.20 (good)
EPT value: 13 (excellent)
Percent Model Affinity: 68% (excellent)
Dominant species:
Cricotopus trifascia gr. (facultative midge) 30%
Stenelmis crenata (facultative beetle) 15%
Thienemannimyia gr. spp. (facultative midge) 9%
Water Quality Assessment: non-impacted

Station 15. A kick sample was taken at Messengerville, opposite the confluence of Gridley Creek. The fauna was similar to that at Station 14, although the biomass was higher. Although the mean of the four parameter values was just within the range of slightly impacted water quality, no substantial difference is shown between the upstream and downstream sites, which are assessed as non-impacted. Water quality at this site is thus corrected to an assessment of non-impacted.

Species richness: 27 (excellent)
Biotic index: 5.53 (good)
EPT value: 9 (good)
Percent Model Affinity: 72% (excellent)
Dominant species:
Cricotopus bicinctus (tolerant midge) 16%
Nais bretscheri (facultative worm) 8%
Anthopotamus sp. (intolerant mayfly) 8%
Water Quality Assessment: slightly, corrected to non-impacted

Station 16. Sampling was conducted above the bridge at Marathon, upstream of the island. Filamentous algae covered many of the rocks, and the fauna appeared enriched but healthy. A high diversity of macroinvertebrates was present, and water quality appeared completely recovered from the Cortland sewage discharge. Water quality was assessed as non-impacted.

Species richness: 30 (excellent)
Biotic index: 5.82 (good)
EPT value: 9 (good)
Percent Model Affinity: 75% (excellent)
Dominant species:
Anthopotamus sp. (intolerant mayfly) 14%
Nais variabilis (tolerant worm) 11%
Cricotopus trifascia gr. (facultative midge) 8%
Water Quality Assessment: non-impacted

Station 17. The site was located at Lisle, about 100 meters below the Route 79 bridge. The river was shallow, and the water temperature was 21° C. All major groups of macroinvertebrates were represented in the fauna, and water quality was assessed as non-

impacted.

Species richness: 29 (excellent)
Biotic index: 5.62 (good)
EPT value: 12 (excellent)
Percent Model Affinity: 64% (good)
Dominant species:
Nais behningi (facultative worm) 12%
Cricotopus bicinctus (tolerant midge) 11%
Limnodrilus hoffmeisteri (tolerant worm) 10%
Water Quality Assessment: non-impacted

LABORATORY DATA SUMMARY

STREAM NAME Tioughnioga River
DRAINAGE 06
DATE SAMPLED 06/11/92
COUNTY Cortland,Broome
SAMPLING METHOD Traveling kick

STATION	01	02	04	08
LOCATION	West Branch above Homer	West Branch below Homer	West Branch Cortland	East Branch Cortland
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME				
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere. For description of tolerance, intolerant = not tolerant of poor water quality; facultative = occur over a wide range of water quality; tolerant = tolerant of poor water quality. 1.	Optioservus fastidit 19 intolerant beetle	Stenonema terminat 13 intolerant mayfly	Nais bretsch 17 facultative worm	Oecetis avara 8 facultative caddisfly
2.	Psephenus sp. 9 intolerant beetle	Undeterm. Turbell 8 facultative flatworm	Cricotopus trifasc 11 facultative midge	Optioservus trivitt 7 intolerant beetle
3.	Paralepto mollis 9 intolerant mayfly	Cricotopus trifasc 6 facultative midge	Tricorythod sp. 7 intolerant mayfly	Brachycent lateral 7 intolerant caddisfly
4.	Drunella cornutel 7 intolerant mayfly	Stenelmis sp. 5 facultative beetle	Serratell deficien 7 intolerant mayfly	Stenelmis crenata 6 facultative beetle
5.	Hemerodrom sp. 5 facultative dance fly	Cricotopus bicinct 4 tolerant midge	Tvetenia vitracie 4 facultative midge	Serratell deficien 6 intolerant mayfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	13 (9)	30 (11)	34 (12)	17 (8)
Trichoptera (caddisflies)	12 (5)	9 (6)	0 (0)	23 (8)
Ephemeroptera (mayflies)	34 (9)	24 (9)	20 (5)	29 (10)
Plecoptera (stoneflies)	0(0)	0 (0)	0 (0)	1 (1)
Coleoptera (beetles)	30 (3)	13 (3)	8 (2)	15 (3)
Oligochaeta (worms)	2 (2)	6 (3)	30 (6)	7 (3)
Others (**)	9 (2)	18 (5)	8 (5)	8 (5)
TOTAL	100 (30)	100 (37)	100 (30)	100 (38)
SPECIES RICHNESS	30	37	30	38
HBI INDEX	3.53	5.07	5.43	4.24
EPT VALUE	14	15	5	19
PMA VALUE	78	78	61	80
FIELD ASSESSMENT	no impact	slt. impact	slt. impact	none to slt
OVERALL ASSESSMENT	non-impacted	non-impacted	slightly impacted	non-impacted

** sowbugs, clams, snails, black flies.

LABORATORY DATA SUMMARY

STREAM NAME Tioughnioga River
DATE SAMPLED 06/11/92
SAMPLING METHOD Traveling kick

DRAINAGE 06
COUNTY Cortland,Broome

STATION	08A	09E	09W	11
LOCATION	Cortland Pt.Watson	Cortland RR bridge	Cortland RR bridge	Cortland Loop Rd.
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME				
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere. For description of tolerance, intolerant = not tolerant of poor water quality; facultative = occur over a wide range of water quality; tolerant = tolerant of poor water quality. 1.	Nais bretsch 16 facultative worm	Stenelmis crenata 13 facultative beetle	Nais bretsch 23 facultative worm	Nais bretsch 30 facultative worm
2.	Tricorythod sp. 12 intolerant mayfly	Limnodrilus hoffmeis 11 tolerant worm	Limnodrilus hoffmeis 19 tolerant worm	Nais variab 11 tolerant worm
3.	Caenis latipen 7 facultative mayfly	Leucrocuta sp. 8 intolerant mayfly	Nais variab 12 tolerant worm	Undet Tubif w/o caps 10 tolerant worm
4.	Rheotany exiguus 7 facultative midge	Nais pardalis 8 tolerant worm	Cricotopus bicinct 6 tolerant midge	Caecidotea sp. 9 tolerant sowbug
5.	Limnodrilus hoffmeis 6 tolerant worm	Rheotany exiguus 7 facultative midge	Tricorythod sp. 5 intolerant mayfly	Cricotopus trifasc 7 facultative midge
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	22 (10)	14 (5)	18 (8)	18 (7)
Trichoptera (caddisflies)	6 (5)	5 (5)	2 (2)	0 (0)
Ephemeroptera (mayflies)	27 (6)	26 (8)	8 (4)	3 (3)
Plecoptera (stoneflies)	1(1)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)	4 (2)	16 (2)	0 (0)	0 (0)
Oligochaeta (worms)	32 (6)	24 (6)	65 (7)	68 (9)
Others (**)	8 (7)	15 (8)	7 (3)	11 (3)
TOTAL	100 (37)	100 (34)	100 (24)	100 (22)
SPECIES RICHNESS	37	34	24	22
HBI INDEX	6.12	5.72	7.41	7.38
EPT VALUE	12	13	6	3
PMA VALUE	71	70	40	36
FIELD ASSESSMENT	slt. impact	slt. impact	sev impact	mod. to sev
OVERALL ASSESSMENT	non-impacted	non-impacted	moderately impacted	moderately impacted

** leeches, sowbugs, clams, snails, crayfish.

LABORATORY DATA SUMMARY

STREAM NAME Tioughnioga River
DATE SAMPLED 06/11/92
SAMPLING METHOD Traveling kick

DRAINAGE 06
COUNTY Cortland, Broome

STATION		12	14	15	16
LOCATION		Blodgett Mills	Hoxie Gorge	Messenger-ville	Marathon
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME					
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere. For description of tolerance, intolerant = not tolerant of poor water quality; facultative = occur over a wide range of water quality; tolerant = tolerant of poor water quality.	1.	Cricotopus trifasc 16 facultative midge	Cricotopus trifasc 30 facultative midge	Cricotopus bicinct 16 tolerant midge	Anthopotam sp. 14 intolerant mayfly
	2.	Nais bretsch 15 facultative worm	Stenelmis crenata 15 facultative beetle	Nais bretsch 8 facultative worm	Nais variab 11 tolerant worm
	3.	Acentrella sp. 9 intolerant mayfly	Thien'myia gr. spp. 9 facultative midge	Anthopotam sp. 8 intolerant mayfly	Cricotopus trifasc 8 facultative midge
	4.	Nais variab 8 tolerant worm	Baetis flavistr 7 intolerant mayfly	Rheotany exiguus 7 facultative midge	Limnodrilus hoffmeis 6 tolerant worm
	5.	Stenelmis crenata 7 facultative beetle	Acentrella sp. 4 intolerant mayfly	Cricotopus trifasc 7 facultative midge	Leucrocuta sp. 6 intolerant mayfly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)					
Chironomidae (midges)		31 (11)	44 (6)	37 (8)	26 (10)
Trichoptera (caddisflies)		0 (0)	5 (3)	2 (1)	1 (1)
Ephemeroptera (mayflies)		17 (5)	26 (10)	29 (8)	34 (8)
Plecoptera (stoneflies)		0(0)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)		9 (3)	18 (4)	10 (2)	10 (2)
Oligochaeta (worms)		37 (8)	1 (1)	16 (5)	24 (5)
Others (**)		6 (4)	6 (4)	6 (3)	5 (4)
TOTAL		100 (31)	100 (28)	100 (27)	100 (30)
SPECIES RICHNESS		31	28	27	30
HBI INDEX		6.08	5.20	5.53	5.82
EPT VALUE		5	13	9	9
PMA VALUE		57	68	72	75
FIELD ASSESSMENT		mod. impact	slt. impact	none to slt	no impact
OVERALL ASSESSMENT		slightly impacted	non-impacted	non-impacted	non-impacted

** sowbugs, clams, crane flies.

LABORATORY DATA SUMMARY

STREAM NAME Tioughnioga River
DATE SAMPLED 06/11/92
SAMPLING METHOD Traveling kick

DRAINAGE 06
COUNTY Cortland, Broome

STATION	17			
LOCATION	Lisle			
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME				
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere. For description of tolerance, intolerant = not tolerant of poor water quality; facultative = occur over a wide range of water quality; tolerant = tolerant of poor water quality.	1. Nais behningi 12 facultative worm 2. Cricotopus bicinct 11 tolerant midge 3. Limnodrilus hoffmeis 10 tolerant worm 4. Nais bretsch 8 facultative worm 5. Anthopotam sp. 5 intolerant mayfly			
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	26 (7)			
Trichoptera (caddisflies)	6 (4)			
Ephemeroptera (mayflies)	20 (7)			
Plecoptera (stoneflies)	1(1)			
Coleoptera (beetles)	12 (3)			
Oligochaeta (worms)	33 (5)			
Others	2 (2)			
TOTAL	100 (29)			
SPECIES RICHNESS	29			
HBI INDEX	5.62			
EPT VALUE	12			
PMA VALUE	64			
FIELD ASSESSMENT	no impact			
OVERALL ASSESSMENT	non-impacted			

FIELD DATA SUMMARY SHEET

STREAM NAME: Tioughnioga River
REACH: Homer to Lisle DATE SAMPLED: 06-11-92
FIELD PERSONNEL INVOLVED: Abele, Bode

STATION	1	2	4	8
ARRIVAL TIME AT STATION	7:35	8:30	10:20	10:45
LOCATION	West Br. Homer	West Br. blw.Homer	West Br. Cortland	East Br. Cortland
PHYSICAL CHARACTERISTICS				
Width (meters)	8	12	20	40
Depth (meters)	0.2	0.4	0.2	0.4
Current speed (cm per sec)	100	125	143	100
Substrate (%)				
rock (> 10 in. or bedrock)	10	10	20	10
rubble (2.5-10 in.)	50	50	50	60
gravel (0.08-2.5 in.)	20	20	20	20
sand (0.06-2.0 mm)	10	10	10	10
silt (0.004-0.06 mm)	10	10		
clay (less than 0.004 mm)				
Embeddedness (%)	50	50	30	30
CHEMICAL MEASUREMENTS				
Temperature (oC)	11.6	16.8	16.6	16.6
Conductivity (umhos)	378	430	465	275
Dissolved Oxygen (mg per l)	9.3	8.4	10.2	8.8
pH	8.1	8.1	8.2	8.0
BIOLOGICAL ATTRIBUTES				
Canopy (%)	70	10	10	0
Aquatic Vegetation				
algae - water column				
algae - filamentous			present	present
algae - diatoms			present	
macrophytes				present
Occurrence of Macroinvertebrates				
Chironomidae (midges)	X	X	X	X
Trichoptera (caddisflies)	X	X	X	X
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	X
Coleoptera (beetles)	X	X	X	X
Oligochaeta (worms)		X	X	
Other (**)	X	X	X	X
ESTIMATED BIOMASS	medium	medium	low	medium
FIELD ESTIMATE OF WATER QUALITY	non	slt	slt	n/s
FIELD COMMENTS		impounded upstream		

** crayfish, clams, blackflies, mites.

FIELD DATA SUMMARY SHEET

STREAM NAME: Tioughnioga River
REACH: Homer to Lisle DATE SAMPLED: 06-11-92
FIELD PERSONNEL INVOLVED: Abele, Bode

STATION	8A	9E	9W	11
ARRIVAL TIME AT STATION	11:15	12:05	12:05	1:20
LOCATION	Cortland Pt.Watson	Cortland RR bridge	Cortland RR bridge	Cortland Loop Rd.
PHYSICAL CHARACTERISTICS				
Width (meters)	60	80	80	20
Depth (meters)	0.6	0.3	0.3	0.7
Current speed (cm per sec)	67	100	100	125
Substrate (%)				
rock (> 10 in. or bedrock)		10	10	20
rubble (2.5-10 in.)	30	30	30	50
gravel (0.08-2.5 in.)	30	20	20	20
sand (0.06-2.0 mm)	30	30	30	10
silt (0.004-0.06 mm)	10	10	10	
clay (less than 0.004 mm)				
Embeddedness (%)	50	50	50	40
CHEMICAL MEASUREMENTS				
Temperature (oC)	17.4	17.6	17.6	18.7
Conductivity (umhos)	397	288	653	515
Dissolved Oxygen (mg per l)	10.1	10.0	10.6	10.7
pH	8.3	8.4	7.9	8.1
BIOLOGICAL ATTRIBUTES				
Canopy (%)	5	10	10	20
Aquatic Vegetation				
algae - water column				
algae - filamentous				
algae - diatoms				present
macrophytes	present			
Occurrence of Macroinvertebrates				
Chironomidae (midges)	X	X	X	X
Trichoptera (caddisflies)	X			
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)			X	
Coleoptera (beetles)	X	X		
Oligochaeta (worms)	X	X	X	X
Other (**)		X	X	X
ESTIMATED BIOMASS	medium	medium	medium	medium
FIELD ESTIMATE OF WATER QUALITY	slt	slt	sev	m/s
FIELD COMMENTS				river divided by island

** leeches, crayfish, dragonflies, damselflies, sowbugs.

FIELD DATA SUMMARY SHEET

STREAM NAME: Tioughnioga River
REACH: Homer to Lisle DATE SAMPLED: 06-11-92
FIELD PERSONNEL INVOLVED: Abele, Bode

STATION	12	14	15	16
ARRIVAL TIME AT STATION	1:45	2:10	2:40	3:10
LOCATION	Blodgett Mills	Hoxie Gorge	Messenger -ville	Marathon
PHYSICAL CHARACTERISTICS				
Width (meters)	40	80	50	70
Depth (meters)	0.5	0.5	0.4	0.6
Current speed (cm per sec)	100	125	125	71
Substrate (%)				
rock (> 10 in. or bedrock)		10	10	10
rubble (2.5-10 in.)	30	50	50	50
gravel (0.08-2.5 in.)	30	20	20	20
sand (0.06-2.0 mm)	20	10	10	10
silt (0.004-0.06 mm)	20	10	10	10
clay (less than 0.004 mm)				
Embeddedness (%)	70	50	50	40
CHEMICAL MEASUREMENTS				
Temperature (oC)	18.9	18.4	18.0	20.0
Conductivity (umhos)	395	386	374	373
Dissolved Oxygen (mg per l)	10.8	10.0	10.0	10.3
pH	8.4	8.3	8.3	8.5
BIOLOGICAL ATTRIBUTES				
Canopy (%)	10	20	10	10
Aquatic Vegetation				
algae - water column				
algae - filamentous		present	present	present
algae - diatoms				
macrophytes	present			
Occurrence of Macroinvertebrates				
Chironomidae (midges)	X	X	X	X
Trichoptera (caddisflies)		X	X	X
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)		X	X	X
Coleoptera (beetles)		X	X	X
Oligochaeta (worms)	X	X	X	
Other (**)			X	X
ESTIMATED BIOMASS	medium	medium	high	medium
FIELD ESTIMATE OF WATER QUALITY	mod	slt	n/s	non
FIELD COMMENTS				

** crayfish, damselflies, mites.

FIELD DATA SUMMARY SHEET

STREAM NAME: Tioughnioga River
REACH: Homer to Lisle DATE SAMPLED: 06-11-92
FIELD PERSONNEL INVOLVED: Abele, Bode

STATION	17			
ARRIVAL TIME AT STATION	3:40			
LOCATION	Lisle			
PHYSICAL CHARACTERISTICS				
Width (meters)	50			
Depth (meters)	0.4			
Current speed (cm per sec)	100			
Substrate (%)				
rock (> 10 in. or bedrock)				
rubble (2.5-10 in.)	50			
gravel (0.08-2.5 in.)	20			
sand (0.06-2.0 mm)	20			
silt (0.004-0.06 mm)	10			
clay (less than 0.004 mm)				
Embeddedness (%)	60			
CHEMICAL MEASUREMENTS				
Temperature (oC)	21.2			
Conductivity (umhos)	367			
Dissolved Oxygen (mg per l)	10.9			
pH	8.7			
BIOLOGICAL ATTRIBUTES				
Canopy (%)	0			
Aquatic Vegetation				
algae - water column				
algae - filamentous	present			
algae - diatoms				
macrophytes	present			
Occurrence of Macroinvertebrates				
Chironomidae (midges)	X			
Trichoptera (caddisflies)	X			
Ephemeroptera (mayflies)	X			
Plecoptera (stoneflies)	X			
Coleoptera (beetles)	X			
Oligochaeta (worms)	X			
Other (**)	X			
ESTIMATED BIOMASS	medium			
FIELD ESTIMATE OF WATER QUALITY	non			
FIELD COMMENTS				

** mites.

Appendix I. BIOLOGICAL METHODS FOR KICK SAMPLING

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

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

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

D. Sample Sorting and Subsampling. In the laboratory the sample is rinsed with tap water in a U.S. No. 40 standard sieve to remove any fine particles left in the residues from field sieving. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula and placed in a petri dish with alcohol. This portion is examined under a dissecting stereomicroscope and 100 organisms are removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70 percent alcohol, and counted. Following identification of a subsample, if the results are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment, additional subsampling may be required.

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species, and the total number of individuals in the sample is recorded on a data sheet. All organisms from the subsample are archived, either slide-mounted or preserved in alcohol.

Appendix II. MACROINVERTEBRATE COMMUNITY PARAMETERS

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

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

3. Biotic index. The Hilsenhoff Biotic Index is 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). Values are listed in Hilsenhoff (1987); additional values are assigned by the NYS Stream Biomonitoring Unit. 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. Percentage similarity as calculated in Washington (1984) 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.

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 Technical Report. 12 pp.

Washington, H.G. 1984. Diversity, biotic, and similarity indices. Water Research 18(6):653-694.

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.

1. Non-impacted

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

2. Slightly impacted

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

3. Moderately impacted

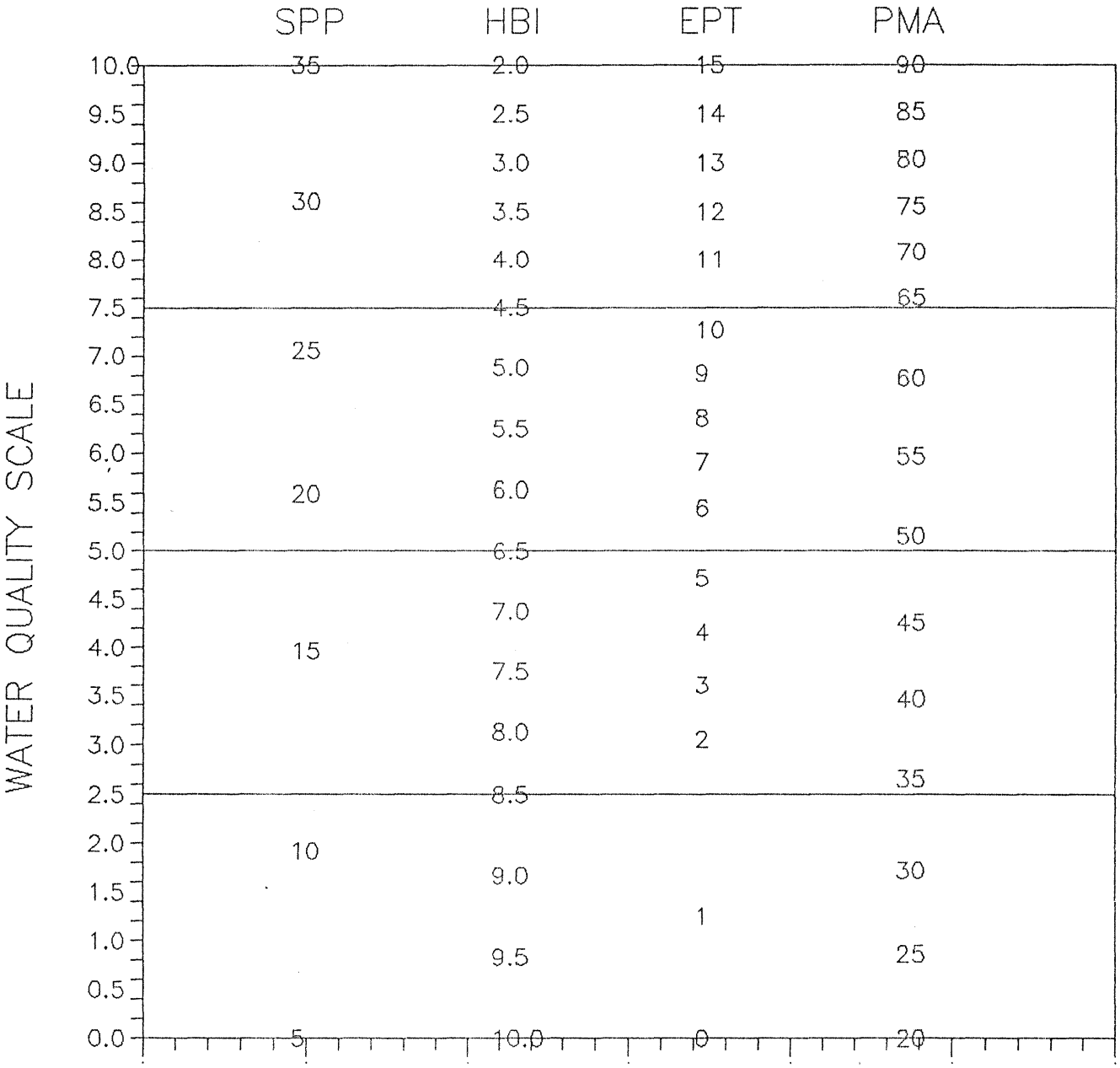
Indices reflect fair water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The percent model affinity value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

4. Severely impacted

Indices reflect poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or less. Mayflies, stoneflies, and caddisflies are rare or absent; EPT value is 0-1. 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. THE "O'BRIEN PLOT" OF INDEX VALUES

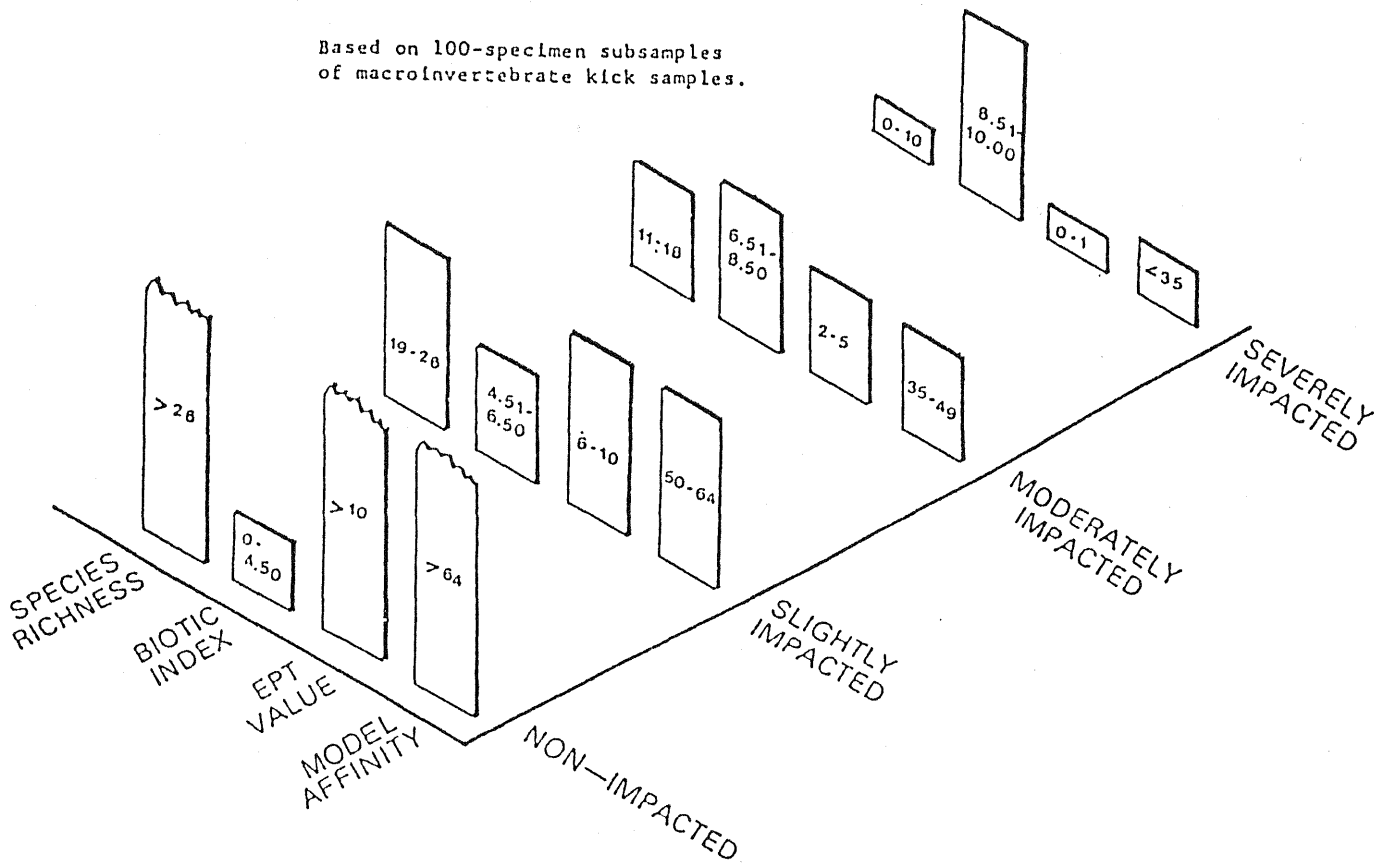
The O'Brien Plot of index values, developed by Mr. Phil O'Brien, Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the four indices defined in Appendix II are converted to a common 0-10 scale as shown in the figure below.



To plot survey data, each site is positioned on the x-axis according to river miles from the mouth, and the scaled values for the four indices are plotted on the common scale. The mean scale value of the four indices is represented by a circle; this value is used for graphing trends between sites, and represents the assessed impact for each site.

Appendix V.

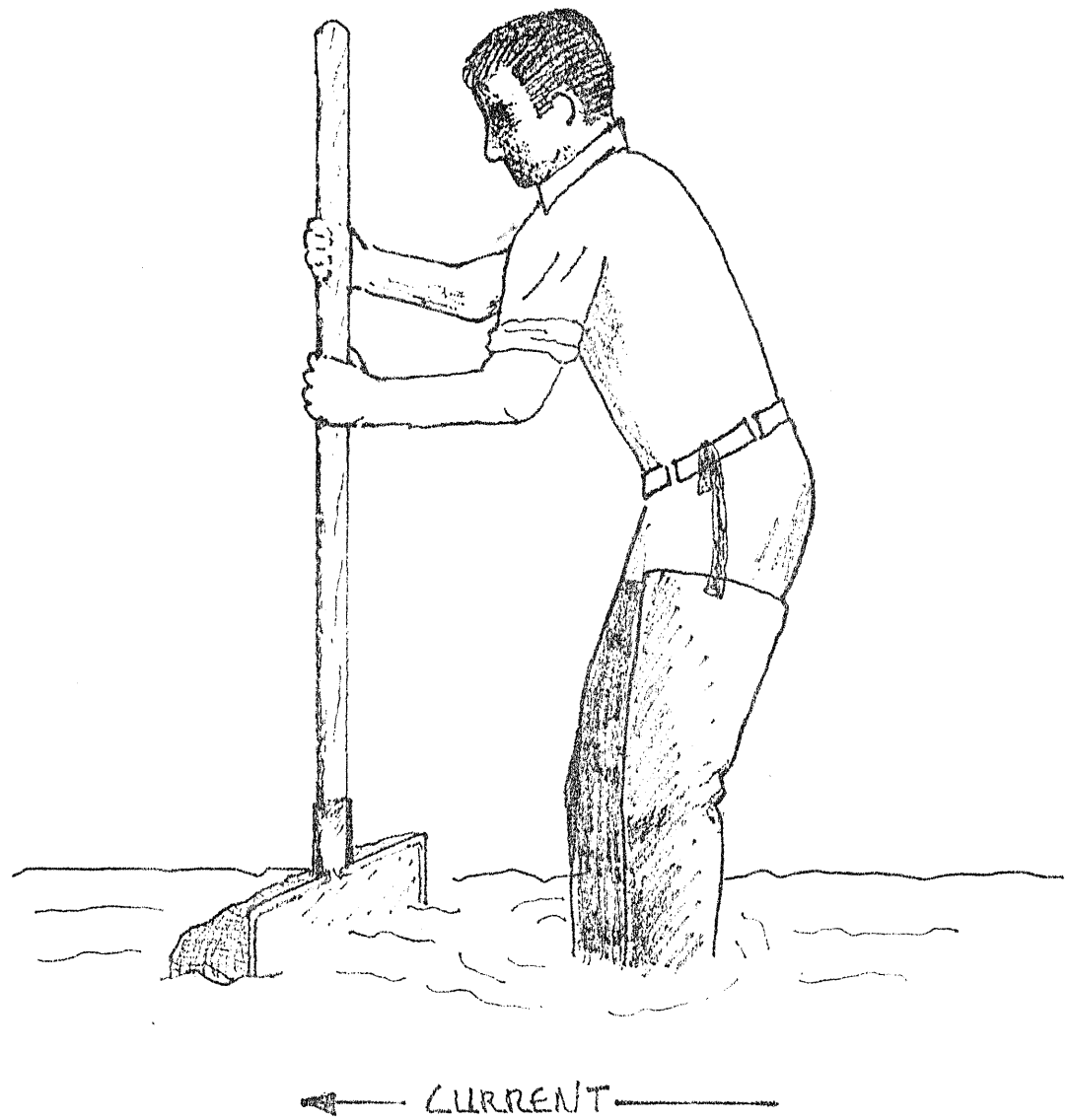
Detection criteria used to determine level of water quality impact in trend monitoring.



Ranges represent expected values for most flowing waters in New York State. Individual assessments of the four parameters are combined to form an overall assessment of impact.

Appendix VI.

THE TRAVELING KICK SAMPLE

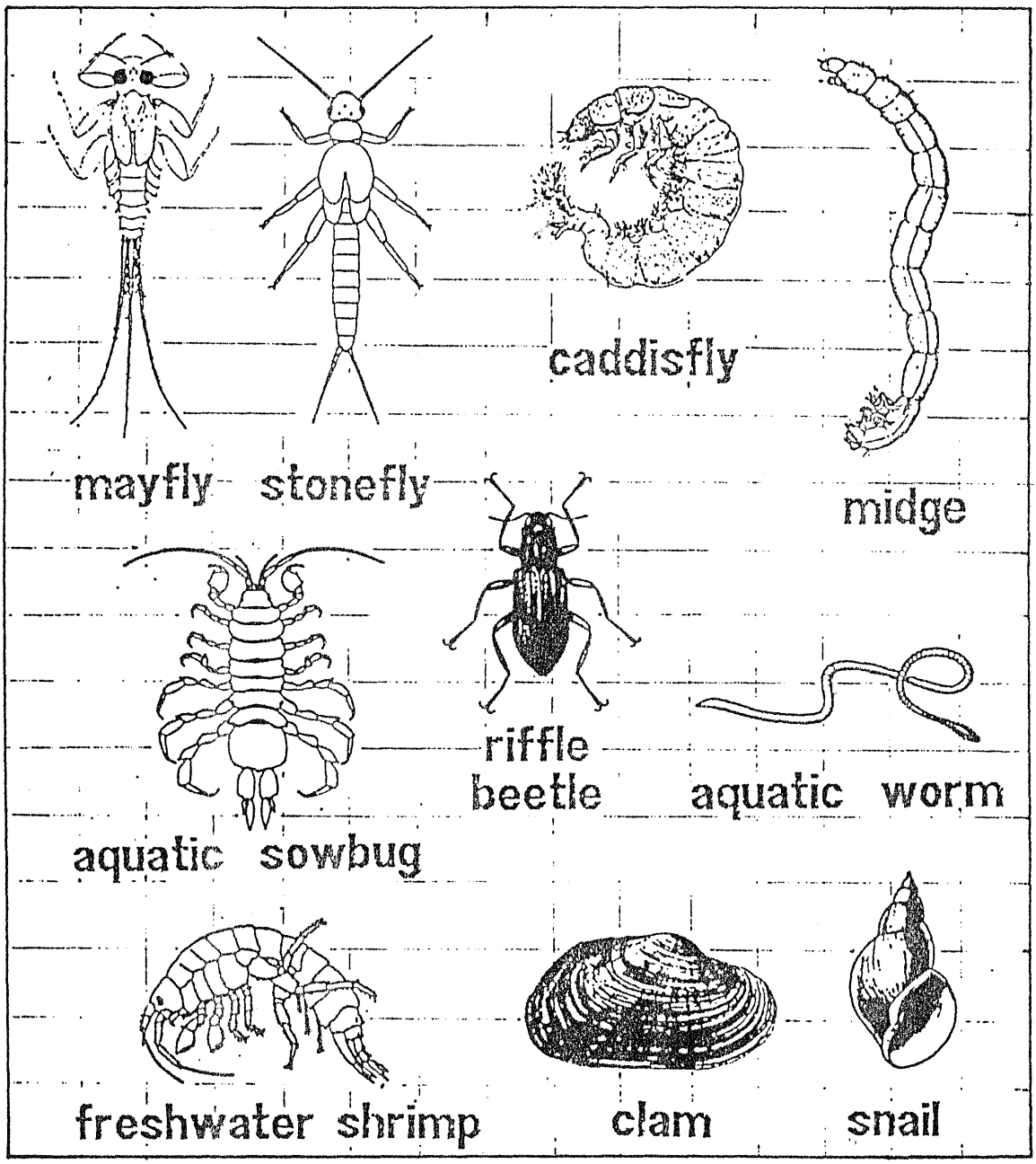


Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current into the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

Appendix VII.

MACROINVERTEBRATES

commonly encountered in streams



Benthic macroinvertebrates are bottom-dwelling animals without backbones that are large enough to be visible without a microscope. The major groups of macroinvertebrates are aquatic insects, worms, crustaceans and mollusks.