New York State
Department of Environmental Conservation

Division of Water

Bronx River

Biological Assessment

1998 Survey

GEORGE E. PATAKI, *Governor*

JOHN P. CAHILL, *Commissioner*

BIOLOGICAL STREAM ASSESSMENT

Bronx River
Bronx and Westchester Counties, New York

Survey date: September 23, 1998
Report date: April 13, 1999

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CONTENTS

Stream: Bronx River, Bronx and Westchester Counties, New York

Reach: Valhalla to Bronx, New York

Background:

The Stream Biomonitoring Unit conducted biological sampling on the Bronx River on September 23, 1998. The purpose of the sampling was to assess general water quality, provide a baseline data set for future studies, and compare to previous studies. Traveling kick samples were taken in riffle areas at four 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. Water quality assessments were based on resident macroinvertebrates (aquatic insects, worms, mollusks, crustaceans). Community parameters used in the determination of water quality included species richness, biotic index, EPT value, and percent model affinity (see Appendices II and III). Table 2 provides a listing of sampling sites, and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by site collection pages, which include the raw invertebrate data from each site and descriptions of each site. Fish sampling was conducted on the Bronx River sites by Doug Carlson, NYS DEC Region 6; these results appear in Table 3. A previous macroinvertebrate study of the Bronx River conducted by C.-Olson in 1997 was used for site selection and comparison of results.

Results and Conclusions:

1. Water quality in the Bronx River is mostly moderately impacted. The best water quality was found at Valhalla, and the poorest water quality was found at White Plains. Impacts were caused primarily by organic wastes and municipal and industrial discharges.

2. Results of this study were nearly identical with results from an independent biological study conducted in 1997 by Charles C.-Olson. These two studies form a solid set of baseline data to use for comparative purposes in future studies of the Bronx River.

3. Assessments based on fish communities correlated well with macroinvertebrate results. The finding of an apparently wild brown trout at the upstream site is an indication of the capability of the Bronx River habitat to sustain trout under suitable water quality conditions.

Discussion:

The purpose of this biological sampling of the Bronx River was to assess general water quality, establish a NYS DEC baseline data set, and compare to results of previous studies. Four sites were sampled from Valhalla downstream to the Bronx. The stream in this reach was 2-7 meters wide and had adequate riffles for sampling macroinvertebrate communities.

A previous macroinvertebrate study of the Bronx River was conducted in 1997 by Charles C.-Olson (1998), currently with the New York City Department of Environmental Protection stream biomonitoring program. The sites sampled in C.-Olson's study formed the basis for site selection in the present study, although the site numbering sequence is reversed. The results of the 1997 study showed the most upstream site to be slightly impacted, and the three downstream sites to be moderately impacted, as in the present study. The greatest decrease in water quality in both studies was found between Valhalla and White Plains (Figures 1 and 2).

Station-by-station results of the present study are very similar to those of C.-Olson (1998). At Valhalla (Station 1), both studies found the invertebrate community strongly dominated by filter-feeding caddisflies, with riffle beetles and mayflies also represented. At White Plains (Station 2), both studies found caddisflies to be greatly reduced, with the community dominated instead by toxic-tolerant midges. At Tuckahoe (Station 3), both studies found caddisflies to be dominant again, followed by midges. At the Bronx (Station 4), both studies found caddisflies and midges to be co-dominant, with black fly larvae also numerous.

Impact Source Determination (ISD), a procedure for identifying types of impacts that exert deleterious effects on a waterbody by calculating similarity to established community models, was used to determine primary factors influencing the Bronx River water quality. These results showed that the upstream reach was influenced primarily by nutrient enrichment, while the river from White Plains downstream was affected by organic wastes and various municipal and/or industrial discharges (Table 1). The finding of low dissolved oxygen (4.4 ppm) and a poor biotic index value at the White Plains site indicates that organic wastes are a problem here. The biotic index is primarily a measure of organic effects on the biological community. Toxic influences were also high at this site.

Fish sampling was conducted at the Bronx River sites on September 23, 1998 by Douglas Carlson (NYS DEC Fisheries, Region 6). Sampling at all sites consisted of electrofishing for approximately 20 minutes, attempting to sample one pool and one riffle. All fish were identified and enumerated at the site and released. Results of the fish sampling are presented in Table 3. Methods for interpretation of fish data with regard to water quality have not yet been standardized for northeastern streams. Two parameters were used in the present study: species richness and Percent Non-tolerant Species. Based on these parameters, water quality was rated as good at Station 1, dropped substantially at Station 2, and recovered slightly at Stations 3 and 4, thus correlating well with macroinvertebrate results (Figure 2). The finding of an apparently wild brown trout at Station 1 is an indication of the capability of the Bronx River to support trout under suitable water quality conditions.

For improving water quality in the Bronx River, discharges upstream of White Plains should be given the highest priority. Storm water runoff from White Plains enters the stream just above Station 2. An unknown discharge, possibly sewage, enters the stream one mile above Station 2, just south of the I-287 bridge (C.-Olson, pers. comm.). Permitted SPDES discharges are listed in Table 5. Future biological monitoring surveys of the Bronx River should look for the appearance of mayflies at downstream sites as indication of improving water quality. The data from the present study, combined with those from C.-Olson's 1997 study, together form a cohesive database for the Bronx River. This can be used for comparative purposes for future monitoring of the stream.

Literature cited

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

C.-Olson, Charles. 1998. Results of a benthic macroinvertebrate survey conducted at four sites on the Bronx River on September 20-21, 1997.

Overview of field data:

On the date of sampling, September 23, 1998, the sites sampled on the Bronx River were 2-7 meters wide, 0.1-0.2 meters deep in riffles, and had current speeds of 40-100 cm/sec in riffles. Dissolved oxygen was 4.4-8.0 mg/l, specific conductance was 320-870 μmhos, pH was 7.4-7.7, and the temperature was 15.6-17.5 °C (60-64 °F). Measurements for each site are found on the field data summary sheets.

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

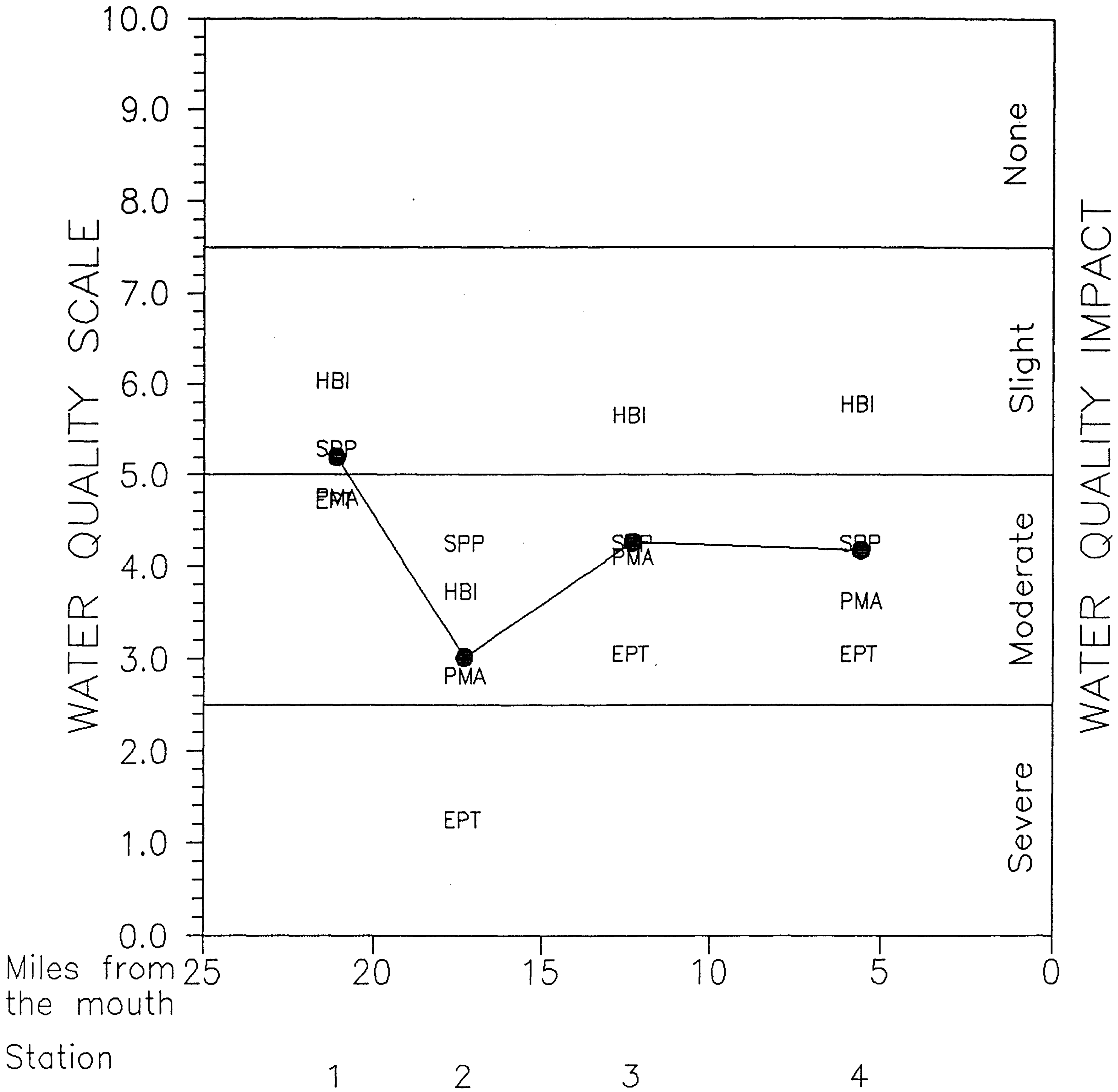


Figure 2. Comparison of 1998 Biological Assessment Profile with results of 1997 invertebrate study by C.-Olson, and 1998 DEC fish study by Carlson. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site, representing species richness, EPT richness, Hilsenhoff Biotic Index, and Percent Model Affinity. See Appendix IV for more complete explanation.

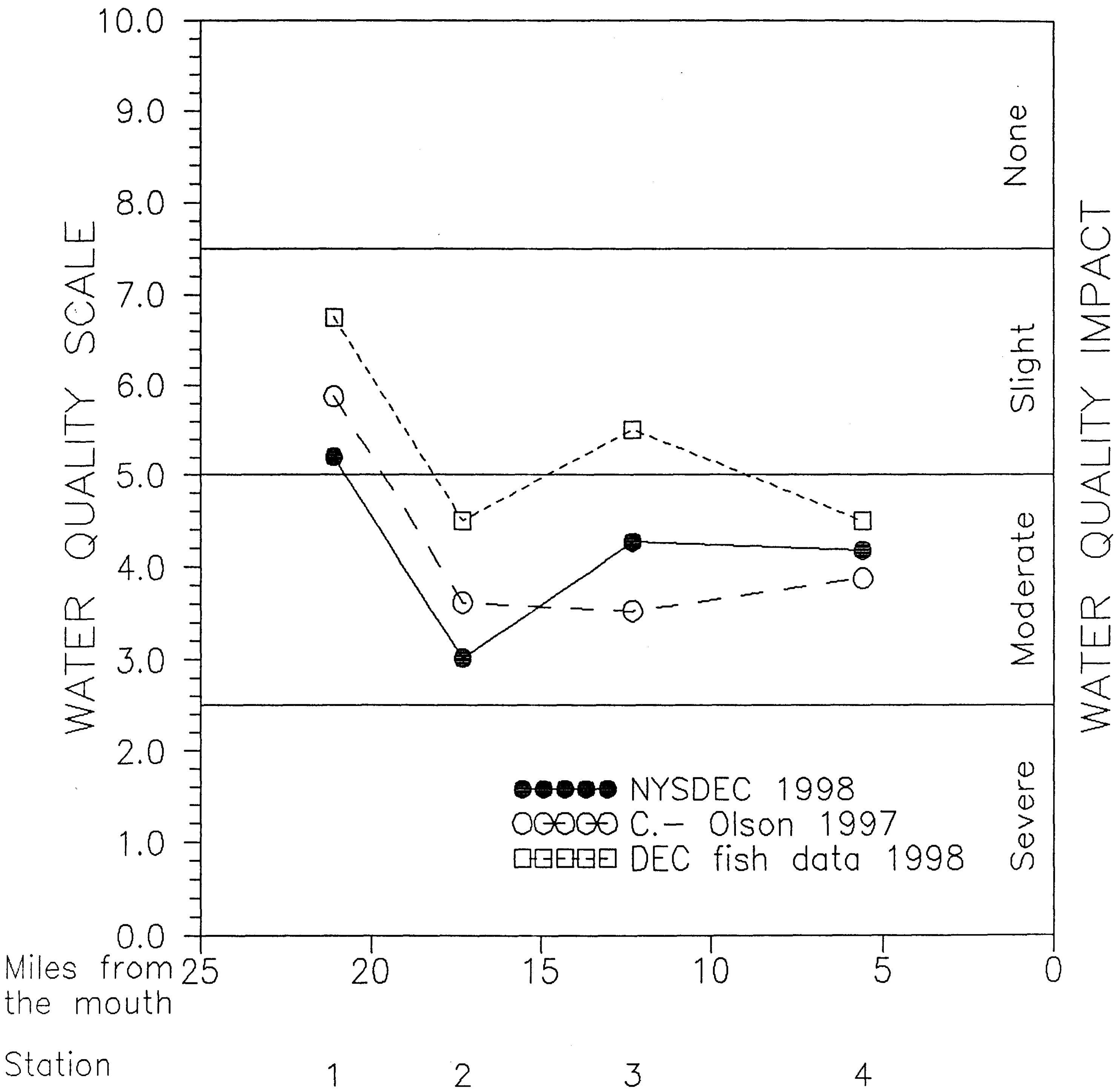


Table 1. Impact Source Determination, Bronx River, 1998. Numbers represent similarity to community type models for each impact category. The highest similarity at each station is highlighted. Similarities less than 50% are less conclusive. See Appendix X for more complete explanation of ISD.

	STATION			
Community Type	BRNX-1	BRNX-2	BRNX-3	BRNX-4
Natural: minimal human impacts	35	29	29	26
Nutrient additions; mostly nonpoint, agricultural	67	34	60	57
Toxic: mostly industrial discharges or urban run-off	58	53	46	47
Organic: sewage effluent, animal wastes	59	59	64	59
Complex: combinations of municipal and industrial discharges	59	56	69	68
Siltation	54	44	46	48

Table 2. STATION LOCATIONS FOR THE BRONX RIVER, WESTCHESTER AND BRONX COUNTIES, NEW YORK (see map).

STATION	LOCATION
01	Valhalla 10 meters above Legion Rd. culvert 21.1 miles above mouth latitude/longitude: 41°04'27"; 73°46'35"
02	White Plains 100 meters below Bronx River Parkway bridge 17.3 miles above mouth latitude/longitude: 41°01'27"; 73°46'59"
03	Tuckahoe bridge above Crestview Station 12.3 miles above mouth latitude/longitude: 40°57'39"; 73°49'15"
04	Bronx 150 meters above East Gun Hill Rd. bridge 5.6 miles above mouth latitude/longitude: 40°52'48"; 73°52'07"

Figure 3	Site Overview Map	Bronx River

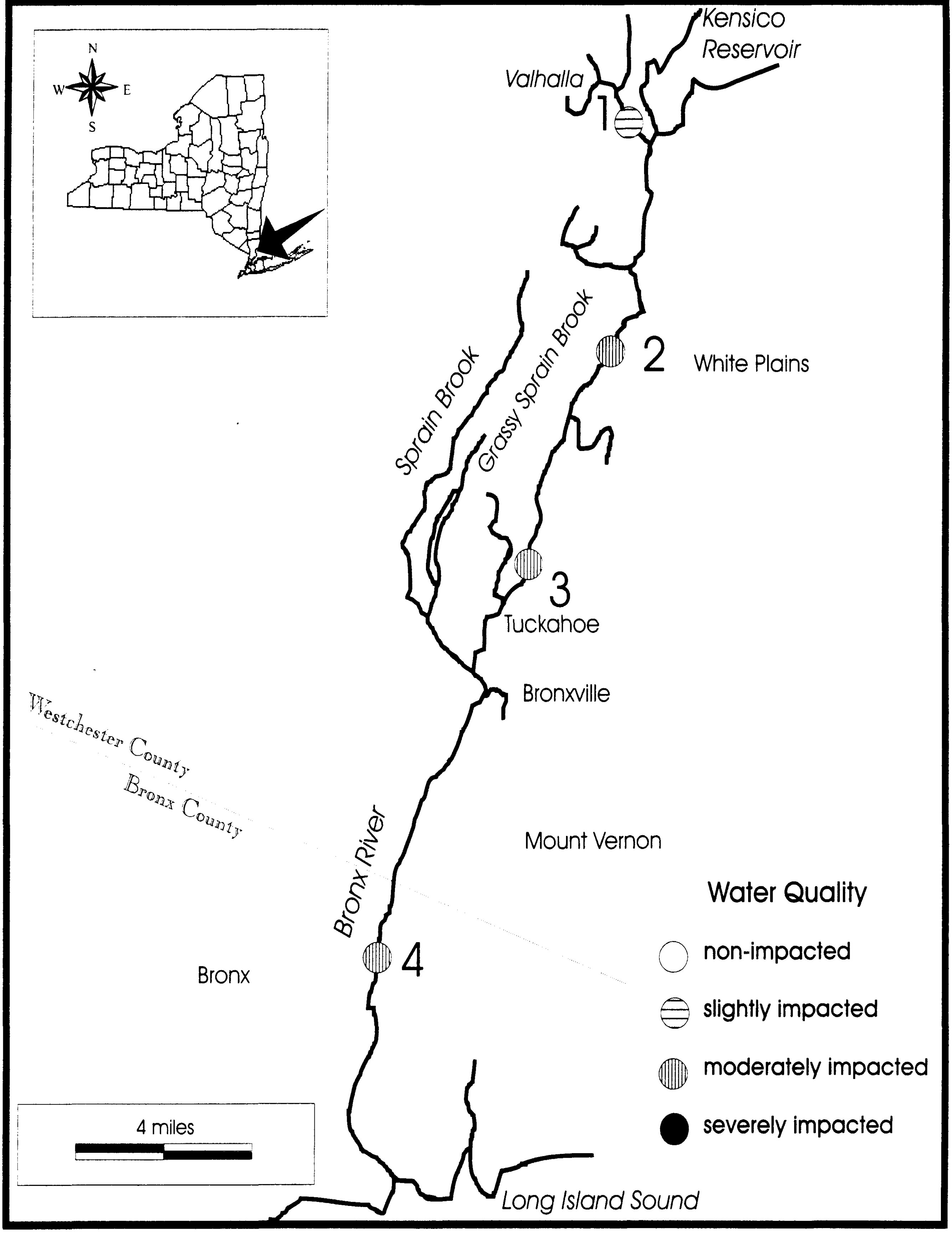
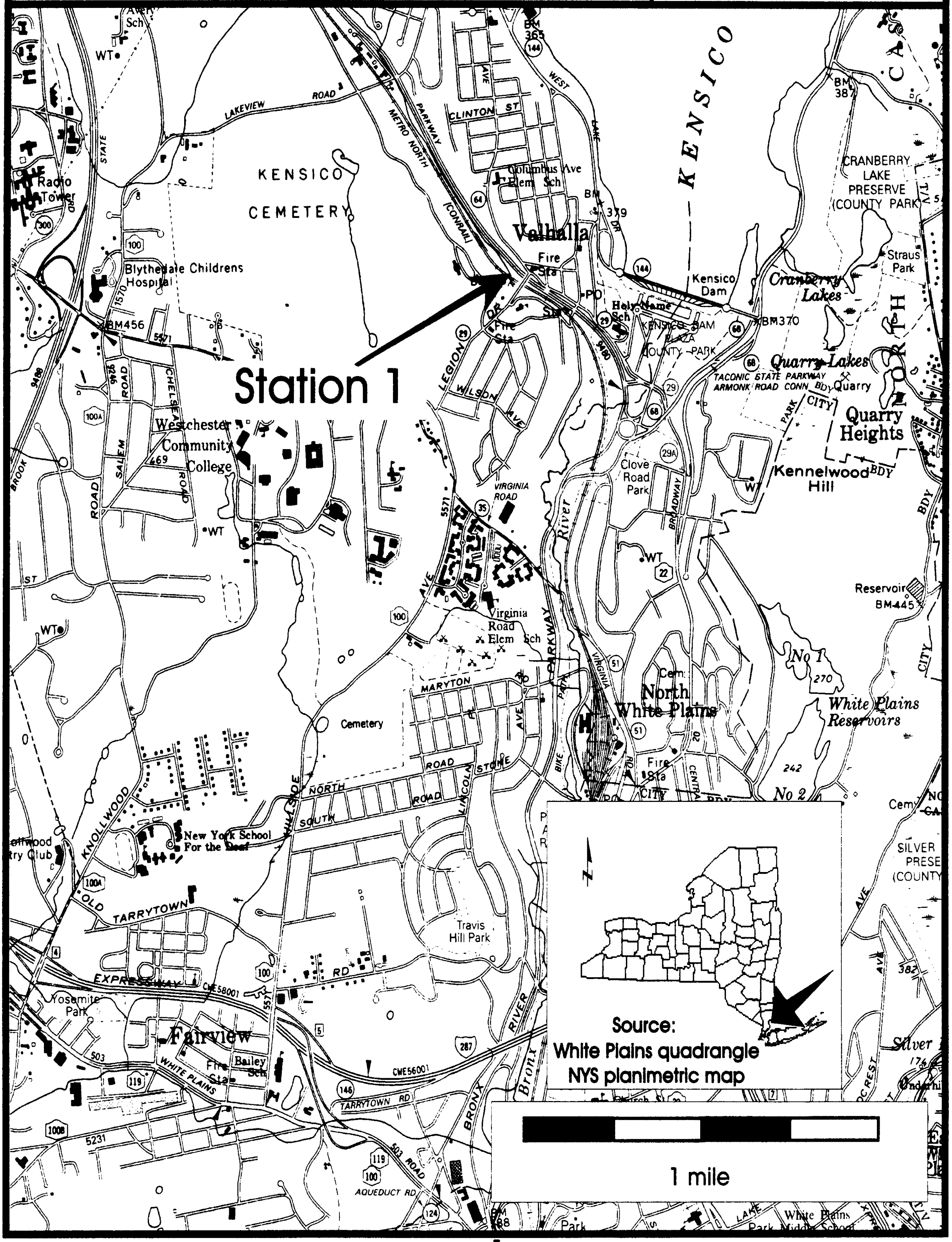
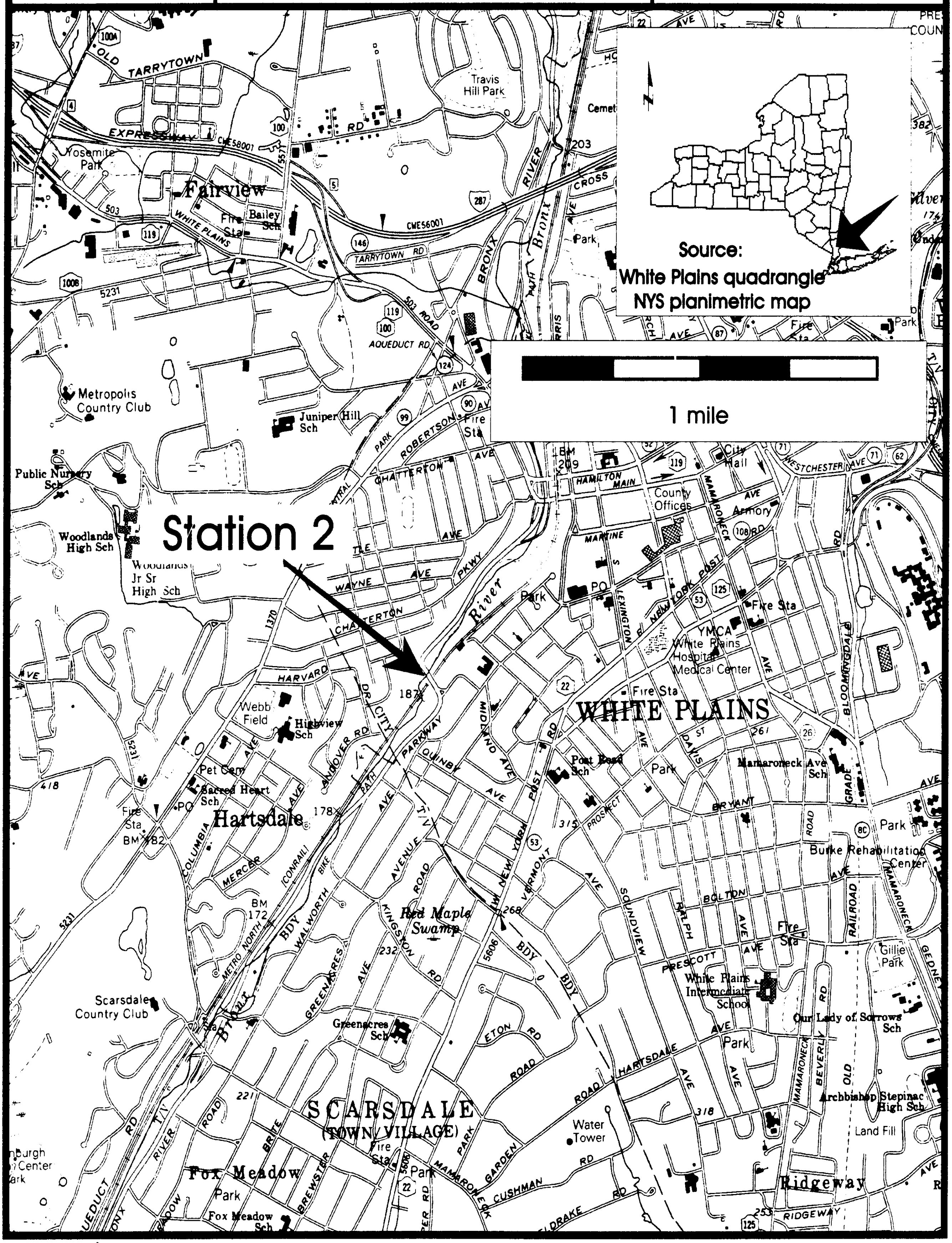


Figure 4a	Site Location Map	Bronx River



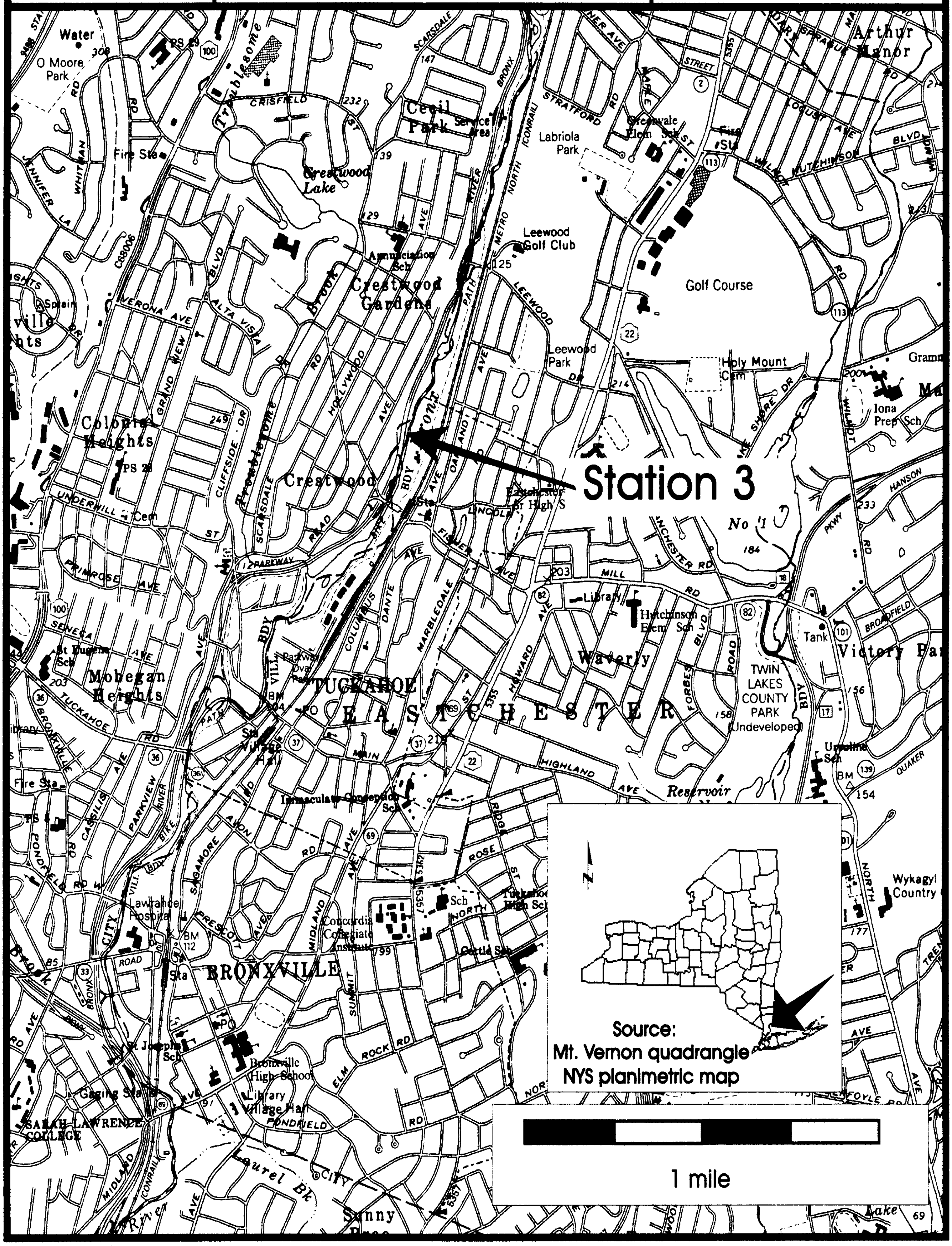
stream flow

Figure 4b	Site Location Map	Bronx River



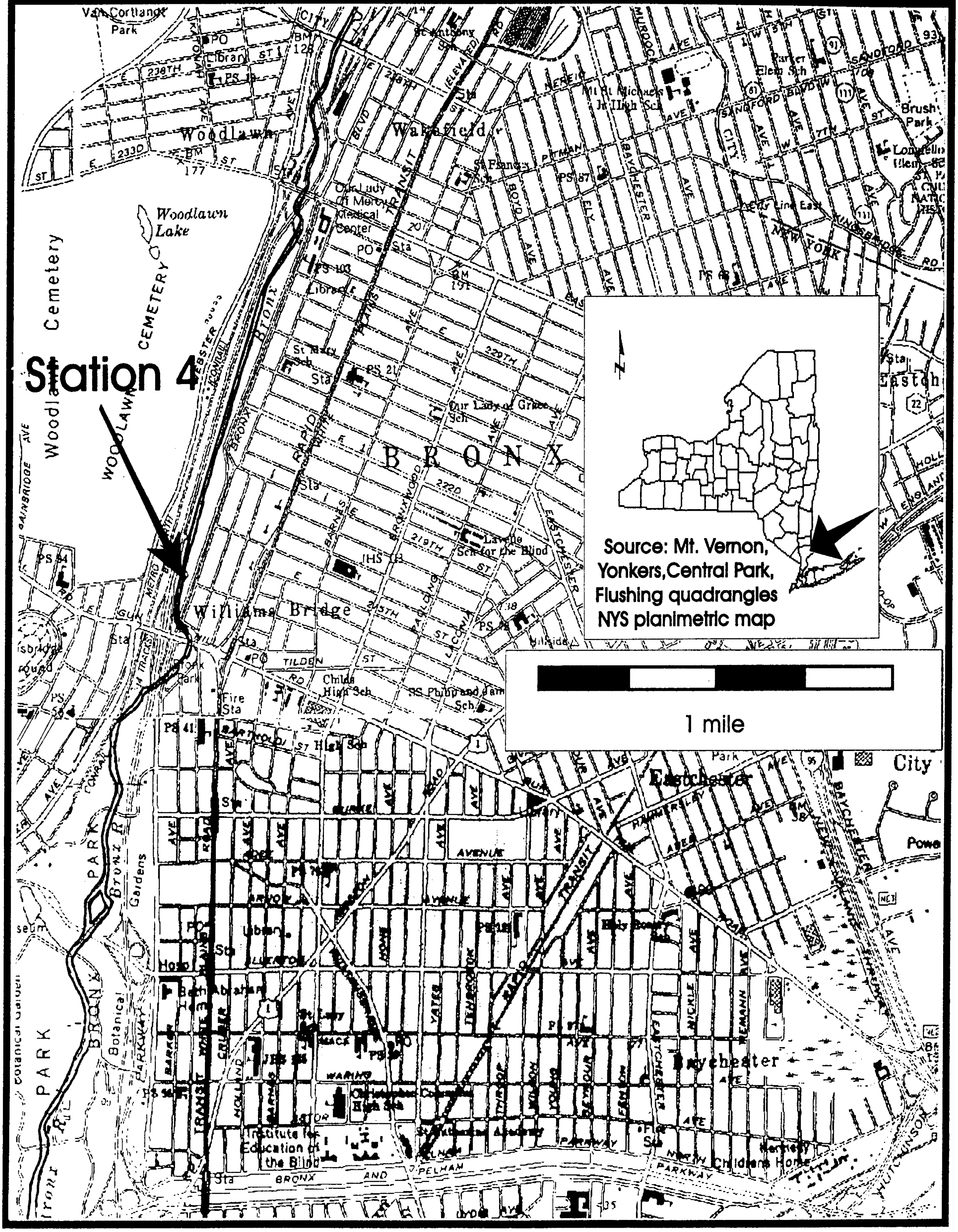
stream flow

Figure 4c	Site Location Map	Bronx River



stream flow

Figure 4d	Site Location Map	Bronx River



stream flow

TABLE 3. FISH COLLECTED IN THE BRONX RIVER, SEPTEMBER 23, 1998.

	BRNX-1	BRNX-2	BRNX-3	BRNX-4
Brown trout	1	.	.	.
Fathead minnow (TOL)	.	.	30	.
Blacknose dace	40	8	5	.
White sucker (TOL)	8	3	14	1
Mummichog (TOL)	.	5	5	6
Redbreast sunfish	.	.	.	2
Pumpkinseed	.	.	4	.
Bluegill	3	.	.	.
Tessellated darter	.	30	8	8
Number of species	4	4	6	4
Weighted richness value*	6	4	6	4
Number of individuals	52	46	66	17
% Non-tolerant species**	75	50	50	50
Overall profile value***	6.75	4.50	5.50	4.50

* richness weighted by stream size using the following provisional formula: for stream width 1-4 meters, value= x+2, where x= richness; for 5-9 meters, x; for 10-19 meters, x-2; for >20 meters; x-4.

** species considered intolerant or intermediate to environmental perturbations; this measure is the inverse of percent tolerant species. 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.

*** profile value = (weighted richness value + 0.1[% non-tolerant species])/2

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.

TABLE 4. MACROINVERTEBRATE SPECIES COLLECTED IN THE BRONX RIVER, WESTCHESTER AND BRONX COUNTIES, NEW YORK, SEPTEMBER 23, 1998.

PLATYHELMINTHES
TURBELLARIA
Undetermined Turbellaria
NEMERTEA
Prostoma graecense (=rubrum)
ANNELIDA
OLIGOCHAETA
Undetermined Lumbricina
Lumbriculidae
Undetermined Lumbriculidae
Enchytraeidae
Undetermined Enchytraeidae
Tubificidae
Undet. Tubificidae w/o cap. setae
Naididae
Dero furcata
Nais communis
Nais pardalis
Nais variabilis
Pristinella jenkinae
HIRUDINEA
Undetermined Hirudinea
MOLLUSCA
GASTROPODA
Physidae
Physella sp.
Ancylidae
Ferrissia sp.
PELECYPODA
Sphaeriidae
Sphaerium sp.
ARTHROPODA
CRUSTACEA
ISOPODA
Asellidae
Caecidotea sp.
AMPHIPODA
Gammaridae
Gammarus sp.
DECAPODA
Cambaridae
Undetermined Cambaridae
INSECTA
EPHEMEROPTERA
Baetidae
Baetis flavistriga
ODONATA
Aeschnidae
Boyeria sp.
Calopterygidae
Calopteryx sp.
COLEOPTERA
Elmidae
Stenelmis crenata
Stenelmis sp.
TRICHOPTERA
Philopotamidae
Chimarra aterrima?
Hydropsychidae
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche bronta
DIPTERA
Tipulidae
Tipula sp.
Simuliidae
Simulium vittatum
Chironomidae
Tanypodinae
Thienemannimyia gr. spp.
Orthocladiinae
Cricotopus bicinctus
Cricotopus tremulus gr.
Cricotopus vierriensis
Nanocladius distinctus
Chironominae
Chironomini
Polypedilum convictum
Polypedilum fallax gr.
Polypedilum illinoense
Polypedilum scalaenum gr.
Tanytarsini
Tanytarsus sp.

TABLE 5. DISCHARGES TO THE BRONX RIVER AND TRIBUTARIES, WESTCHESTER AND BRONX COUNTIES, NEW YORK

SPDES NO.	FACILITY NAME/OPERATOR	LATITUDE/LONGITUDE
BRONX RIVER		
0006165	LORAL ELECTRONICS SYSTEMS	404932 735303
0037354	DITMAS C/O TERMINNALLE BRONX PLANT	404926 735309
0033219	USV/RORER PHARMACEUTICAL CORP. REVLON HEALTH CARE GROUP R&D DIV ENG DPT	405700 735000
0091804	VALENTE INDUSTRIES CORP. - WHITE PLAINS CONCRETE PLANT	410338 734623
0214795	EXXON CO. U.S.A. - EXXON SERVICE STA.(3-7336)-381	405730 734915
SPRAIN BROOK		
0250929	SPRAIN BROOK CON EDISON OF NY - DUNWOODIE CENTRAL SUBSTATION	405630 735115
0106828	SPRAIN BROOK GREENBURGH (T) DPW TOWN HIGHWAY - GARAGES	410050 734945
0248509	SPRAIN BROOK MOBIL OIL CORP. SCARSDALE REMEDIATION PROJECT S/S 06-N5A	405630 735115
OTHER TRIBUTARIES		
0251291	GRASSY SPRAIN BROOK CON EDISON OF NY - SPRAIN BROOK CENTRAL SUBSTATION	
0248169	BRONX RIVER TRIB GREENBURGH CENTRAL SCHOOL DISTRICT NO.7 - BUS GARAGE	410200 734700
0259276	KENSICO RESERVOIR BRONX RIVER TRIB NYC DEP CATSKILL/DELAWARE FILTRATION PILOT PROJECT	410636 734358 410507 734634
0234061	BRONX RIVER TRIB - no additional information	410300 734824
0248207	BRONX RIVER TRIB - no additional information	405657 734931

STREAM SITE:	Bronx River Station 1
LOCATION:	Valhalla, New York, upstream of the Legion Road culvert
DATE:	September 23, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

ANNELIDA				
OLIGOCHAETA		Lumbriculidae	Undetermined Lumbriculidae	1
		Tubificidae	Undet. Tubificidae w/o cap. setae	1
		Naididae	Nais communis	2
			Pristinella jenkinae	1
MOLLUSCA				
	GASTROPODA	Physidae	Physella sp.	5
ARTHROPODA				
CRUSTACEA				
	ISOPODA	Asellidae	Caecidotea sp.	1
	AMPHIPODA	Gammaridae	Gammarus sp.	3
INSECTA				
	EPHEMEROPTERA	Baetidae	Baetis flavistriga	1
	ODONATA	Aeschnidae	Boyeria sp.	1
		Calopterygidae	Calopteryx sp.	2
	COLEOPTERA	Elmidae	Stenelmis crenata	9
	TRICHOPTERA	Philopotamidae	Chimarra aterrima?	20
		Hydropsychidae	Cheumatopsyche sp.	5
			Hydropsyche betteni	32
			Hydropsyche bronta	1
	DIPTERA	Tipulidae	Tipula sp.	2
		Chironomidae	Thienemannimyia gr. spp.	1
			Cricotopus bicinctus	7
			Polypedilum illinoense	5

SPECIES RICHNESS	19 (good)
BIOTIC INDEX	5.68 (good)
EPT RICHNESS	5 (fair)
MODEL AFFINITY	48 (fair)
ASSESSMENT	slightly impacted

DESCRIPTION The sampling site was located in Valhalla, upstream of the Legion Road culvert. The habitat was considered less than optimal, with a substrate dominated by gravel and sand. A 9-inch brown trout, assumed to be wild, was found at this site. The invertebrate fauna was heavily dominated by filter-feeding caddisflies, although mayflies were present. Based on the indices, overall water quality was assessed as slightly impacted.

STREAM SITE:	Bronx River Station 2
LOCATION:	White Plains, New York, 100 meters downstream of the Bronx River Parkway bridge
DATE:	September 23, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

NEMERTEA		Prostoma graecense (=rubrum)	1
ANNELIDA			
OLIGOCHAETA	Enchytraeidae	Undetermined Enchytraeidae	3
	Tubificidae	Undet. Tubificidae w/o cap. setae	5
	Naididae	Dero furcata	1
		Nais pardalis	3
		Nais variabilis	19
HIRUDINEA		Undetermined Hirudinea	1
ARTHROPODA			
INSECTA			
COLEOPTERA	Elmidae	Stenelmis sp.	1
TRICHOPTERA	Hydropsychidae	Hydropsyche betteni	8
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	8
		Cricotopus bicinctus	22
		Cricotopus tremulus gr.	4
		Cricotopus vierriensis	6
		Polypedilum fallax gr.	1
		Polypedilum illinoense	15
		Polypedilum scalaenum gr.	2

SPECIES RICHNESS	16 (fair)
BIOTIC INDEX	7.52 (fair)
EPT RICHNESS	1 (poor)
MODEL AFFINITY	36 (fair)
ASSESSMENT	moderately impacted

DESCRIPTION This site was in White Plains, 100 meters downstream of the Bronx River Parkway bridge. The stream substrate was an adequate mixture of rubble, gravel, and sand; most rocks were covered with moss and silt. The dissolved oxygen level was only 4.4 ppm, compared to 8.0 at Station 1. The invertebrate fauna appeared meager, consisting of midges, worms, and caddisflies. The indices clearly denoted moderately impacted water quality.

STREAM SITE: Bronx River Station 3
LOCATION: Tuckahoe, New York, upstream of Crestview Station
DATE: September 23, 1998
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 individuals

NEMERTEA			Prostoma graecense (=rubrum)	3
PLATYHELMINTHES				
	TURBELLARIA		Undetermined Turbellaria	8
ANNELIDA				
	OLIGOCHAETA		Undetermined Lumbricina	2
		Enchytraeidae	Undetermined Enchytraeidae	1
		Tubificidae	Undet. Tubificidae w/o cap. setae	1
MOLLUSCA				
	GASTROPODA	Ancylidae	Ferrissia sp.	1
	PELECYPODA	Sphaeriidae	Sphaerium sp.	1
ARTHROPODA				
	INSECTA			
	TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	19
			Hydropsyche betteni	42
	DIPTERA	Chironomidae	Thienemannimyia gr. spp.	2
			Cricotopus bicinctus	1
			Cricotopus vierriensis	1
			Polypedilum convictum	2
			Polypedilum illinoense	10
			Polypedilum scalaenum gr.	1
			Tanytarsus sp.	5

SPECIES RICHNESS	16 (fair)
BIOTIC INDEX	5.97 (good)
EPT RICHNESS	2 (fair)
MODEL AFFINITY	44 (fair)
ASSESSMENT	moderately impacted

DESCRIPTION The kick sample was taken in Tuckahoe, upstream of Crestview Station. The stream substrate consisted of rubble, gravel, and sand, an adequate habitat. The dissolved oxygen level was 5.9 ppm, up from Station 2. The invertebrate fauna was strongly dominated by filter-feeding caddisflies, and the indices denoted moderately impacted water quality.

STREAM SITE:	Bronx River Station 4
LOCATION:	Bronx, New York, upstream of East Gun Hill Road bridge
DATE:	September 23, 1998
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 individuals

PLATYHELMINTHES				
	TURBELLARIA		Undetermined Turbellaria	3
ANNELIDA				
	OLIGOCHAETA	Naididae	Nais pardalis	1
HIRUDINEA			Undetermined Hirudinea	2
MOLLUSCA				
	PELECYPODA	Sphaeriidae	Sphaerium sp.	3
ARTHROPODA				
	CRUSTACEA			
	ISOPODA	Asellidae	Caecidotea sp.	1
	AMPHIPODA	Gammaridae	Gammarus sp.	2
	DECAPODA	Cambaridae	Undetermined Cambaridae	1
	INSECTA			
	TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	36
			Hydropsyche betteni	6
	DIPTERA	Simuliidae	Simulium vittatum	11
		Chironomidae	Thienemannimyia gr. spp.	1
			Cricotopus tremulus gr.	5
			Nanocladius distinctus	2
			Polypedilum convictum	1
			Polypedilum illinoense	20
			Tanytarsus sp.	5

SPECIES RICHNESS	16 (fair)
BIOTIC INDEX	5.88 (good)
EPT RICHNESS	2 (fair)
MODEL AFFINITY	41 (fair)
ASSESSMENT	moderately impacted

DESCRIPTION The site was located upstream of the East Gun Hill Road bridge in the Bronx. The habitat was considered good, with a rubble/gravel/sand riffle, and adequate current speed and canopy. The invertebrate fauna was dominated by caddisflies and midges, and water quality was assessed as moderately impacted.

LABORATORY DATA SUMMARY

STREAM NAME Bronx River
DATE SAMPLED 09/23/98
SAMPLING METHOD Traveling kick

DRAINAGE 17
COUNTY Westchester
Bronx

STATION		01	02	03	04
LOCATION		Valhalla - Legion Rd.	White Plains	Tuckahoe - Crestview	Bronx - Gun Hill Rd.
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME					
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere in this report.	1.	Hydropsyche betteni 32 facultative caddisfly	Cricotopus bicinct 22 tolerant midge	Hydropsyche betteni 42 facultative caddisfly	Cheumatopsy sp. 36 facultative caddisfly
	2.	Chimarra aterrima 20 intolerant caddisfly	Nais variab 19 tolerant worm	Cheumatopsy sp. 19 facultative caddisfly	Polypedilum illinoe 20 facultative midge
Intolerant = not tolerant of poor water quality; Facultative = occurring over a wide range of water quality; Tolerant = tolerant of poor water quality.	3.	Stenelmis crenata 9 facultative beetle	Polypedilum illinoe 15 facultative midge	Polypedilum illinoe 10 facultative midge	Simulium vittatum 11 facultative black fly
	4.	Cricotopus bicinct 7 tolerant midge	Thien'myia gr. spp. 8 facultative midge	Undeterm. Turbell 8 facultative flatworm	Hydropsyche betteni 6 facultative caddisfly
	5.	Polypedilum illinoe 5 facultative midge	Hydropsyche betteni 8 facultative caddisfly	Tanytarsus sp. 5 facultative midge	Cricotopus tremulus 5 facultative midge
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)					
Chironomidae (midges)		13 (3)	58 (7)	22 (7)	34 (6)
Trichoptera (caddisflies)		58 (4)	8 (1)	61 (2)	42 (2)
Ephemeroptera (mayflies)		1 (1)	0 (0)	0 (0)	0 (0)
Plecoptera (stoneflies)		0 (0)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)		9 (1)	1 (1)	0 (0)	0 (0)
Oligochaeta (worms)		5 (4)	31 (5)	4 (3)	1 (1)
Others (**)		14 (6)	2 (2)	13 (4)	23 (7)
TOTAL		100 (19)	100 (16)	100 (16)	100 (16)
SPECIES RICHNESS		19	16	16	16
HBI INDEX		5.68	7.52	5.97	5.88
EPT VALUE		5	1	2	2
PMA VALUE		48	36	44	41
FIELD ASSESSMENT		mod impact	sev impact	sev impact	sev impact
OVERALL ASSESSMENT		slightly impacted	moderately impacted	moderately impacted	moderately impacted

** scuds (Sta. 1,4); sowbugs (Sta. 1,4); leeches (Sta. 2); snails (Sta.1,3)

FIELD DATA SUMMARY				
STREAM NAME: Bronx River REACH: Valhalla to Bronx FIELD PERSONNEL INVOLVED: Abele, Myers,Carlson			DATE SAMPLED: 09/23/1998	
STATION	01	02	03	04
ARRIVAL TIME AT STATION	1:00	12:05	11:30	10:30
LOCATION	Valhalla - Legion Rd.	White Plains - Bronx R. Pkway	Tuckahoe - Crestview Sta.	Bronx - East Gun Hill Rd.
PHYSICAL CHARACTERISTICS				
Width (meters)	2	7	5	5
Depth (meters)	0.1	0.2	0.2	0.2
Current speed (cm per sec.)	40	65	70	100
Substrate (%)				
rock (> 10 in., or bedrock)		20	10	20
rubble (2.5 - 10 in.)	10	20	40	40
gravel (0.08 - 2.5 in.)	40	20	20	20
sand (0.06 - 2.0 mm)	30	20	10	10
silt (0.004 - 0.06 mm)	20	20	20	10
clay (< 0.004 mm)				
Embeddedness (%)	50	20	20	20
CHEMICAL MEASUREMENTS				
temperature (° C)	15.6	16.0	16.9	17.5
specific conductance (μmhos)	320	730	870	690
D.O. (mg per l)	8.0	4.4	5.9	6.4
pH	7.7	7.4	7.6	7.5
BIOLOGICAL ATTRIBUTES				
canopy (%)	90	80	70	80
Aquatic Vegetation				
algae - suspended in water column				
algae - attached, filamentous		present		
algae - diatoms			present	
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X			
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)				
Megaloptera (dobsonflies, alderflies)				X
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X	X	X
Simuliidae (black flies)				X
Decapoda (crayfish)	X			
Gammaridae (scuds)	X			
Mollusca (snails, clams)			X	
Oligochaeta (worms)	X		X	
Other	X		X	X
FIELD ASSESSMENT	moderate	severe	severe	severe

Appendix I. BIOLOGICAL METHODS FOR KICK SAMPLING

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

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

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

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

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

Appendix II. MACROINVERTEBRATE COMMUNITY PARAMETERS

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

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

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

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

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

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

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

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

Appendix III. LEVELS OF WATER QUALITY IMPACT IN STREAMS.

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

1. Non-impacted

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

2. Slightly impacted

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

3. Moderately impacted

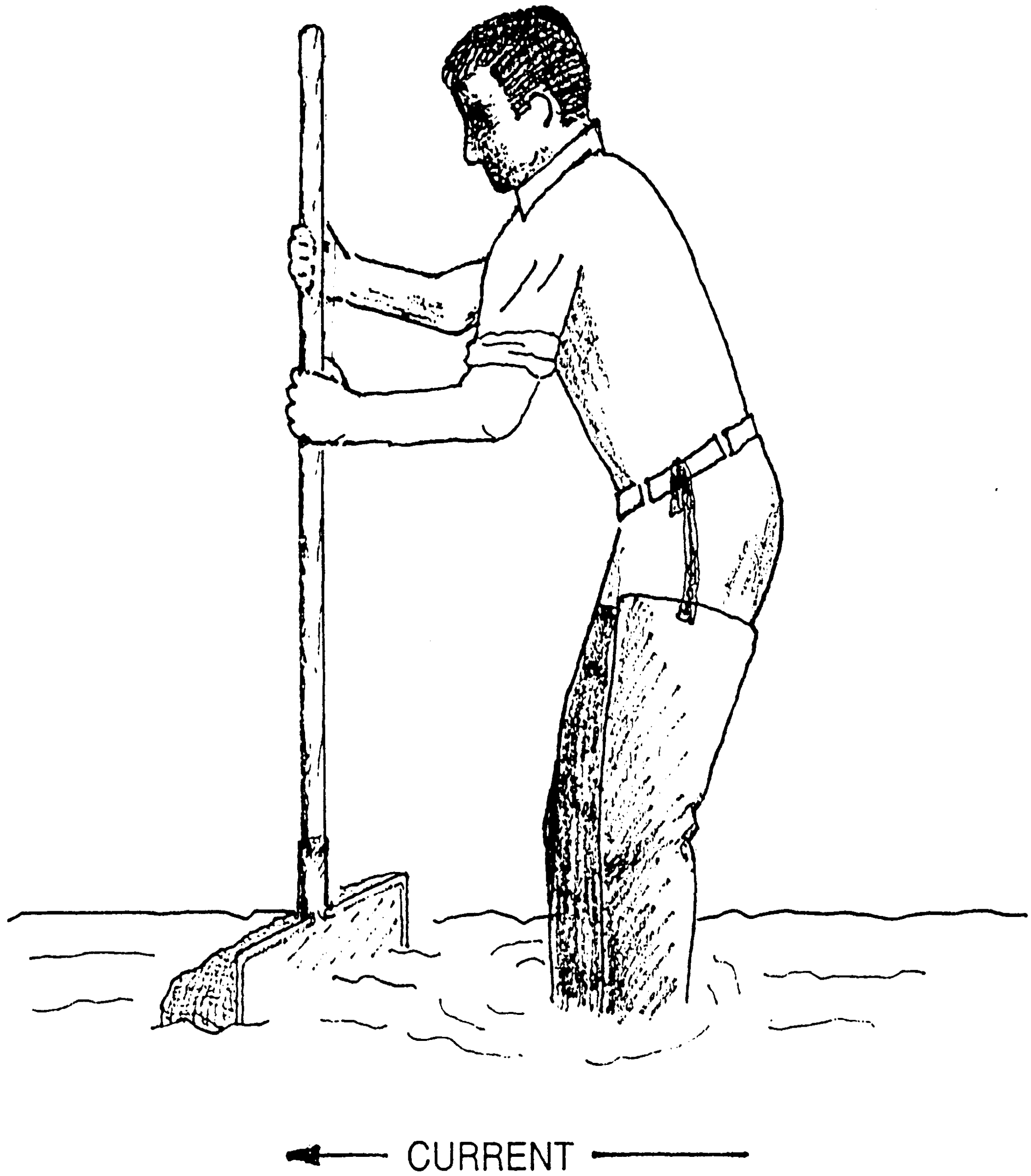
Indices reflect fair water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT value is 2-5. The biotic index value is 6.51-8.50.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

4. Severely impacted

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

Appendix VI.

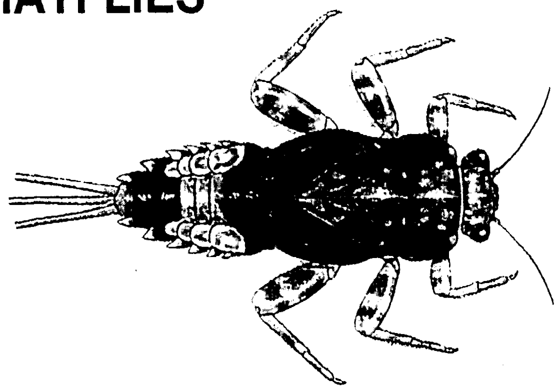
THE TRAVELING KICK SAMPLE



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

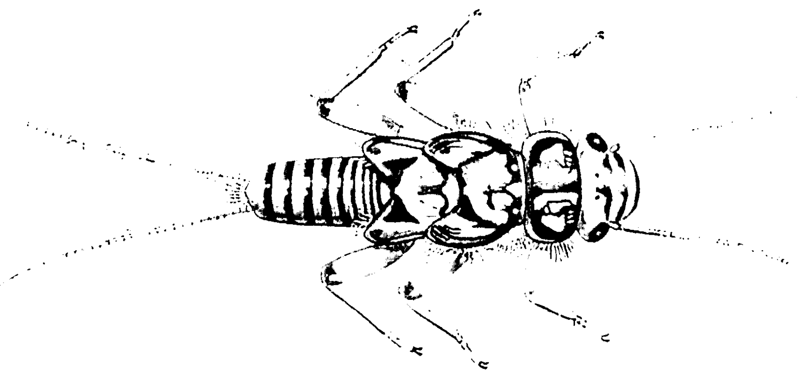
AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

MAYFLIES



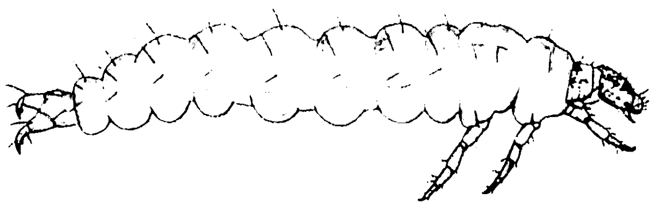
Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.

STONEFLIES



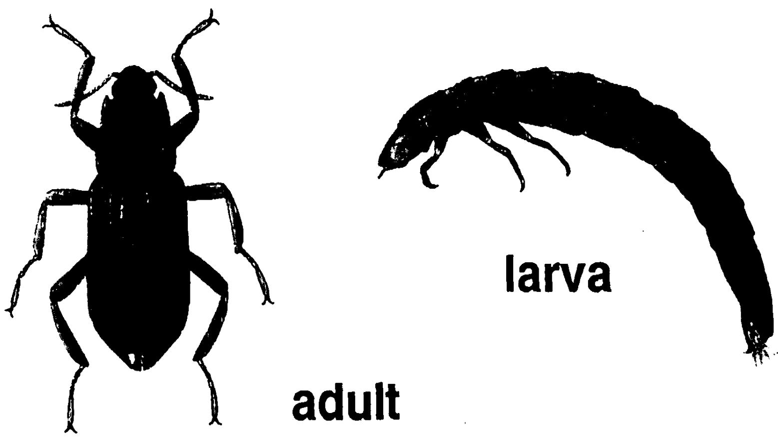
Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained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

CADDISFLIES



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

BEETLES



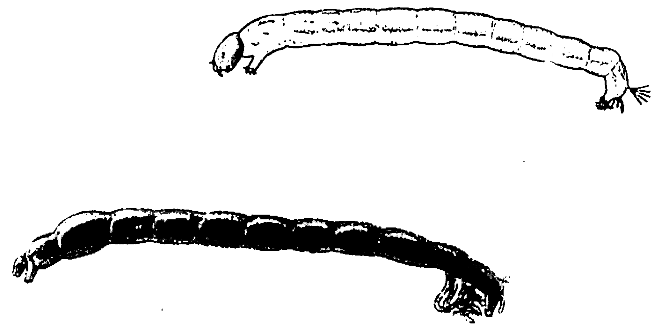
The most common beetles in streams are riffle beetles and water pennies. Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

Illustrations by Arwin Provonsha
In McCafferty: Aquatic Entomology

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

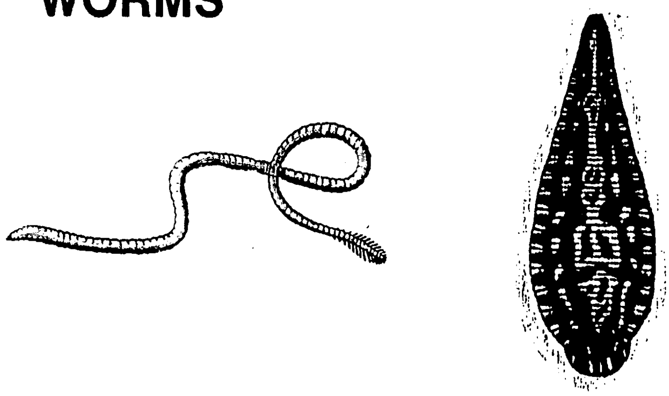
MIDGES

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



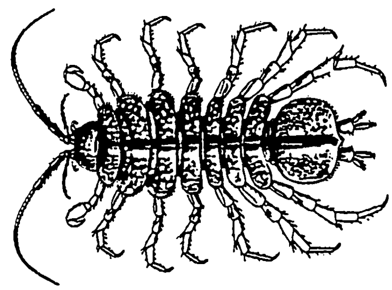
WORMS

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



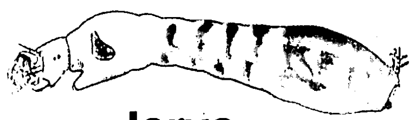
SOWBUGS

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

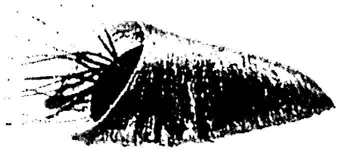


BLACK FLIES

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



larva



pupa

APPENDIX VIII. THE RATIONALE OF BIOLOGICAL MONITORING

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

Concept

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

Advantages

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

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

Limitations

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

APPENDIX IX. GLOSSARY

assessment: a diagnosis or evaluation of water quality

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

biomonitoring: the use of biological indicators to measure water quality

community: a group of populations of organisms interacting in a habitat

drainage basin: an area in which all water drains to a particular waterbody; watershed

EPT value: the number of species of mayflies, stoneflies, and caddisflies in a sample

facultative: occurring over a wide range of water quality; neither tolerant nor intolerant of poor water quality

fauna: the animal life of a particular habitat

impact: a change in the physical, chemical, or biological condition of a waterbody

impairment: a detrimental effect caused by an impact

index: a number, metric, or parameter derived from sample data used as a measure of water quality

intolerant: unable to survive poor water quality

macroinvertebrate: a larger-than-microscopic invertebrate animal that lives at least part of its life in aquatic habitats

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

organism: a living individual

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

riffle: wadeable stretch of stream usually with a rubble bottom and sufficient current to have the water surface broken by the flow; rapids

species richness: the number of macroinvertebrate species in a sample or subsample

station: a sampling site on a waterbody

survey: a set of samplings conducted in succession along a stretch of stream

tolerant: able to survive poor water quality

APPENDIX X. METHODS FOR IMPACT SOURCE DETERMINATION

Definition Impact Source Determination (ISD) is the procedure for identifying types of impacts that exert deleterious effects on a waterbody. While the analysis of benthic macroinvertebrate communities has been shown to be an effective means of determining severity of water quality impacts, it has been less effective in determining what kind of pollution is causing the impact. Impact Source Determination uses community types or models to ascertain the primary factor influencing the fauna.

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

Use of the ISD methods Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural", lacking an impact. In the graphic representation of ISD, the highest similarity of each source type is identified, and similarities that are within 5% of the highest. Similarities less than 50% are considered less conclusive. The determination of impact source type is used in conjunction with assessment of severity of water quality impact to provide an overall assessment of water quality.

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

NATURAL

	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Isonychia</u>	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
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
<u>Psephenus</u>	5	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	5	-	20	5	5	-	5	5	5	5	-	-	-
<u>Promoresia</u>	5	-	-	-	-	-	25	-	-	-	-	-	-
<u>Stenelmis</u>	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	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	5	5	-	-	10	-	-	5	-	-	5	5	5
<u>Eukiefferiella/ Tvetenia</u>	5	5	10	-	-	5	5	5	-	5	-	5	5
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	5	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u>	-	-	-	-	-	20	-	-	10	20	20	5	-
<u>Polypedilum</u> (all others)	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

	NONPOINT NUTRIENTS, PESTICIDES									TOXIC				
	A	B	C	D	E	F	G	H	I	A	B	C	D	E
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-	5
OLIGOCHAETA	-	-	-	5	-	-	-	-	-	-	10	20	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	5	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	10	10	-	20	10
GAMMARIDAE	-	-	-	5	-	-	-	-	-	5	-	-	-	5
Isonychia	-	-	-	-	-	-	-	5	-	-	-	-	-	-
BAETIDAE	5	15	20	5	20	10	10	5	10	15	10	20	-	-
HEPTAGENIIDAE	-	-	-	-	5	5	5	5	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	5	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	5	-	-	5	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	5	-	-	5	-	5	5	-	-	-	-	-	-	-
Optioservus	10	-	10	5	-	-	15	5	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	15	-	10	15	5	25	5	10	10	15	-	40	35
PHILOPOTAMIDAE	15	5	-	5	-	25	5	-	-	10	-	-	-	-
HYDROPSYCHIDAE	15	15	15	25	10	35	20	45	20	20	10	15	10	35
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	5	-	15	5	5	-	-	-	40	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	5	-	20	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	-	-	-	-	-	5	-	-	5	10	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	10	15	10	5	-	-	-	-	5	15	10	25	10	5
Eukiefferiella/ Tvetenia	-	15	10	5	-	-	-	-	5	-	-	20	10	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	-	5	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	20	10	5	10	5	10	-	-	-	-
Tanytarsini	10	10	10	5	20	5	5	10	-	-	-	-	-	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100