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Division of Water

Biological Assessment

Crum Elbow Creek

1995 Survey



New York State Department of Environmental Conservation
GEORGE E. PATAKI, Governor

MICHAEL D. ZAGATA, Commissioner

BIOLOGICAL STREAM ASSESSMENT

Crum Elbow Creek
Dutchess County, New York

Survey date: September 13, 1995
Report date: October 25, 1995

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Stream: Crum Elbow Creek, Dutchess County, New York

Reach: Hyde Park vicinity

Background:

Biological sampling was performed by the Stream Biomonitoring Unit on lower Crum Elbow Creek on September 13, 1995. The purpose of the sampling was to assess general water quality, particularly in relation to prior discharges of alum to the stream by the water treatment plant. At 4 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 2 provides a listing of sampling sites, and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. We thank Mr. John Sansalone of DEC Region 3 for assistance in this survey.

Results and Conclusions:

1. Invertebrate communities in Crum Elbow Creek downstream of the former water treatment plant showed no adverse impacts attributable to alum applications. The site immediately downstream of the plant exhibited the most diverse fauna in the study area. Clean-water indicators were found at all sites: mayflies, stoneflies, caddisflies, riffle beetles, and hellgrammites.
2. A sampling of the pond bottom exhibited a typical pond fauna, with no apparent effects of alum applications.

Discussion:

The purpose of this study was to determine if invertebrate communities in lower Crum Elbow Creek showed any indications of impact from prior discharges of alum to the stream from the former Hyde Park water treatment plant. The effects of alum application on benthic invertebrates were reported on in another invertebrate survey - of Spring Brook, a small stream in the Cattaraugus Creek watershed (Bode et al., 1995). Crayfish collected at the downstream site in Spring Brook exhibited levels of aluminum in their tissues that exceeded the New York State provisional levels of concern (as in Bode et al., 1991). In Spring Brook, community level changes were subtle but discrete, having minimal effects on most metrics, but changing community composition so that a recognizable community type indicative of toxic stress was evident. The change was most evident by comparing dominant organisms at upstream and downstream sites. The five dominant organisms were compared because they could reasonably be expected to be found in a 100-organism subsample. Comparing presence/absence of less numerous species, one could not always expect such a species to be found in a 100-organism subsample. Of the five dominant species at the upstream site, three were entirely absent from the 100-organism subsample at the downstream site. Two of these, Optioservus, a riffle beetle, and Cheumatopsyche, a caddisfly, were considered to be intolerant of high aluminum levels, based on the Spring Brook sampling, and their absence may be an indicator of aluminum impact.

In the present survey, no indications of toxic stress were found at any of the sites downstream of the discharge. All four metrics at the downstream site improved compared to the upstream site: species richness, biotic index, percent model affinity, and EPT richness. Comparing the five dominant organisms at Station 1 above the former water treatment plant with Station 2 below the plant (Table 1), there was no loss of any of these species. Most of these species are relatively intolerant of most pollutants. Clearly this site showed no toxic impact attributable to alum applications.

Stations 3 and 4, on the Vanderbilt Mansion grounds, were both affected by impoundment/lake effect, producing a fauna dominated by fingernail clams and filtering caddisfly larvae. Station 4 was additionally influenced by its bedrock habitat type, which further limited the fauna. Comparing the five most numerous species at Stations 1 and 2 upstream, species continuity was maintained, despite the high numbers of fingernail clams below the impoundments (Stations 3 and 4). Taking these factors into consideration, there was no discernible toxic impact at these sites.

Using Impact Source Determination (Appendix X) to indicate primary factors influencing the fauna, Station 1 was influenced by silt and/or nonpoint runoff, Station 2 was most similar to natural or non-impact community types, and Stations 3 and 4 were primarily influenced by impoundment effects. No invertebrate communities showed toxic influences.

A bottom sample was also taken from the pond of Crum Elbow Creek just upstream of Route 9. This sample consisted of muck and aquatic plants, and is not directly comparable to the stream riffle sites. It was evaluated using lake and river bottom sediment criteria (Ponar criteria). Using these criteria, the pond bottom fauna was within the limits

of normal non-impacted pond invertebrate communities. No toxic impacts were evident.

Organisms were collected for tissue analysis at two sites: crayfish were collected at Station 3, and hellgrammites were collected at Station 4. These samples have been submitted for analysis, but results are not expected until 1996. Since the communities at these sites displayed no evidence of toxic impact, the tissue analysis results will be reported in memorandum form at a later date only if contaminant levels exceed provisional levels of concern.

Literature cited:

Bode, R.W., M.A. Novak, and L.E. Abele. 1991. Quality assurance work plan for biological stream monitoring in New York State. New York State Department of Environmental Conservation Technical Report. 79 pages.

Bode, R.W., M.A. Novak, and L.E. Abele. 1995. Biological stream assessment, Cattaraugus Creek. New York State Department of Environmental Conservation Technical Report. 52 pages.

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.

Overview of field data:

On the date of sampling, September 13, 1995, Crum Elbow Creek at the sites sampled was 2-10 meters wide, 0.1-0.2 meters deep in riffles, and had current speeds of 45-80 cm/sec in riffles. Dissolved oxygen was 7.9-8.9 mg/l, specific conductance was 516-573 μ mhos, pH was 8.0-8.3, and the temperature was 16.3-17.6 °C (61-64 °F). Measurements for each site are found on the field data summary sheets.

Figure 1. Biological Assessment Profile of index values, lower Crum Elbow Creek, 1995. SPP= species richness, EPT= EPT value, HBI= Hilsenhoff Biotic Index, PMA= Percent Model Affinity. Values are plotted on a normalized scale of water quality. The line connects the mean of the four values for each site. See Appendix IV for more complete explanation.

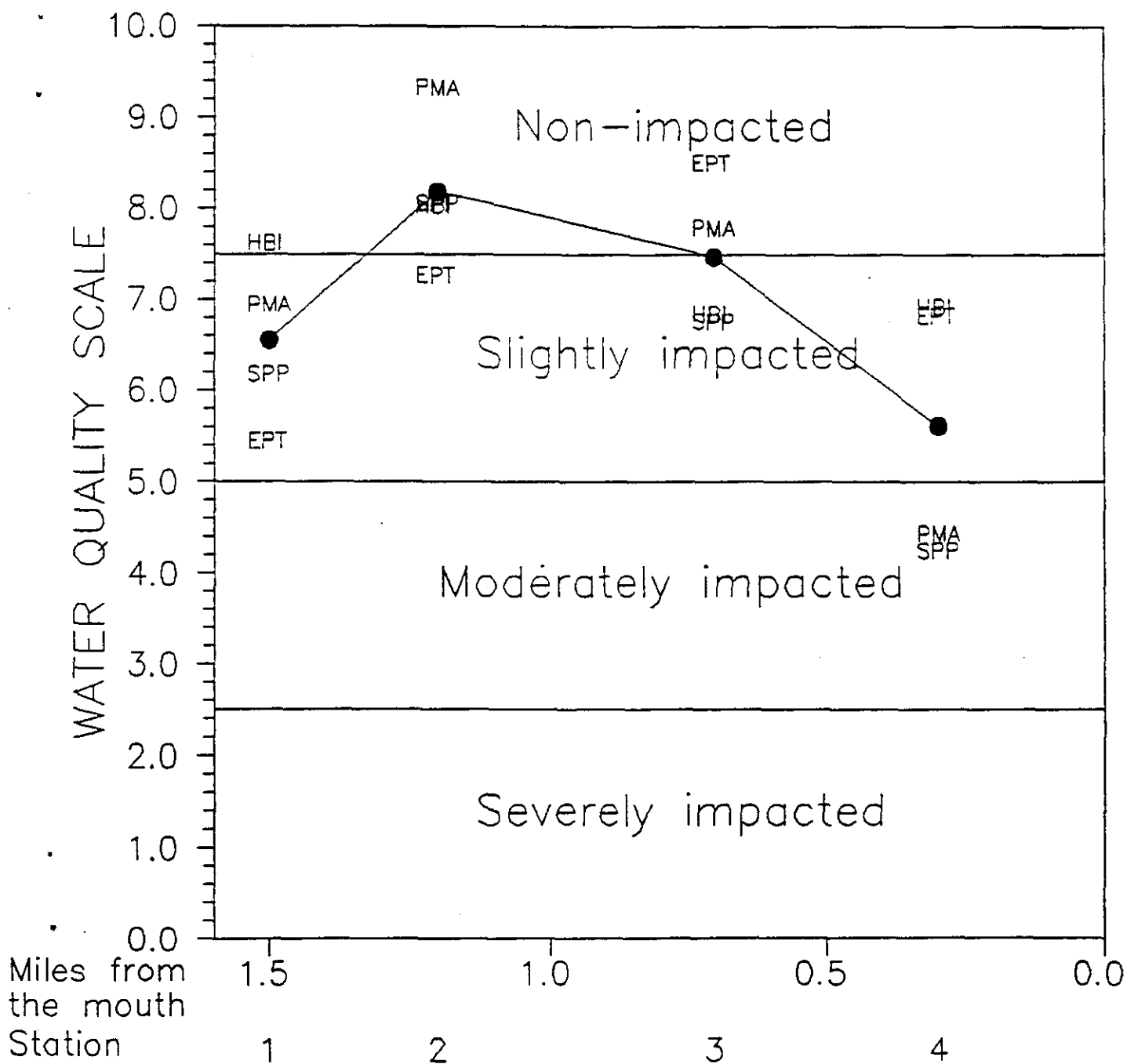


Table 1. Percent contribution of dominant invertebrate taxa in lower Crum Elbow Creek

	Station			
	1	2	3	4
Fingernail clams				
<u>Sphaerium</u> sp.	0	0	23	40 *
Mayflies				
<u>Isonychia</u> <u>bicolor</u>	12	17	12	2
<u>Caenis</u> sp.	1	10	1	0
Stoneflies				
<u>Acroneuria</u> <u>abnormis</u>	8	8	1	4
Beetles				
<u>Psephenus</u> <u>herricki</u>	1	10	1	0
<u>Optioservus</u> spp.	4	7	0	2
<u>Stenelmis</u> spp.	24	2	4	21
Caddisflies				
<u>Chimarra</u> sp.	0	0	1	9
<u>Cheumatopsyche</u> sp.	10	7	11	6
<u>Hydropsyche</u> <u>betteni</u>	5	4	10	2
Midges				
<u>Rheotanytarsus</u> <u>exiguus</u> gr.	16	1	11	0

* The number of Sphaerium sp. at Station 4 was limited to 40 to preclude skewed metrics; original sample sorting percentage for this species was 51.

Notes on species identifications: Optioservus spp. appears as Optioservus trivittatus at two sites and Optioservus sp. at one site, since species identifications are possible only with adults. Stenelmis spp. appears as Stenelmis concinna at two sites and Stenelmis sp. at two sites, since species identifications are possible only with adults.

Figure 2	Station location map	Crum Eibow Creek
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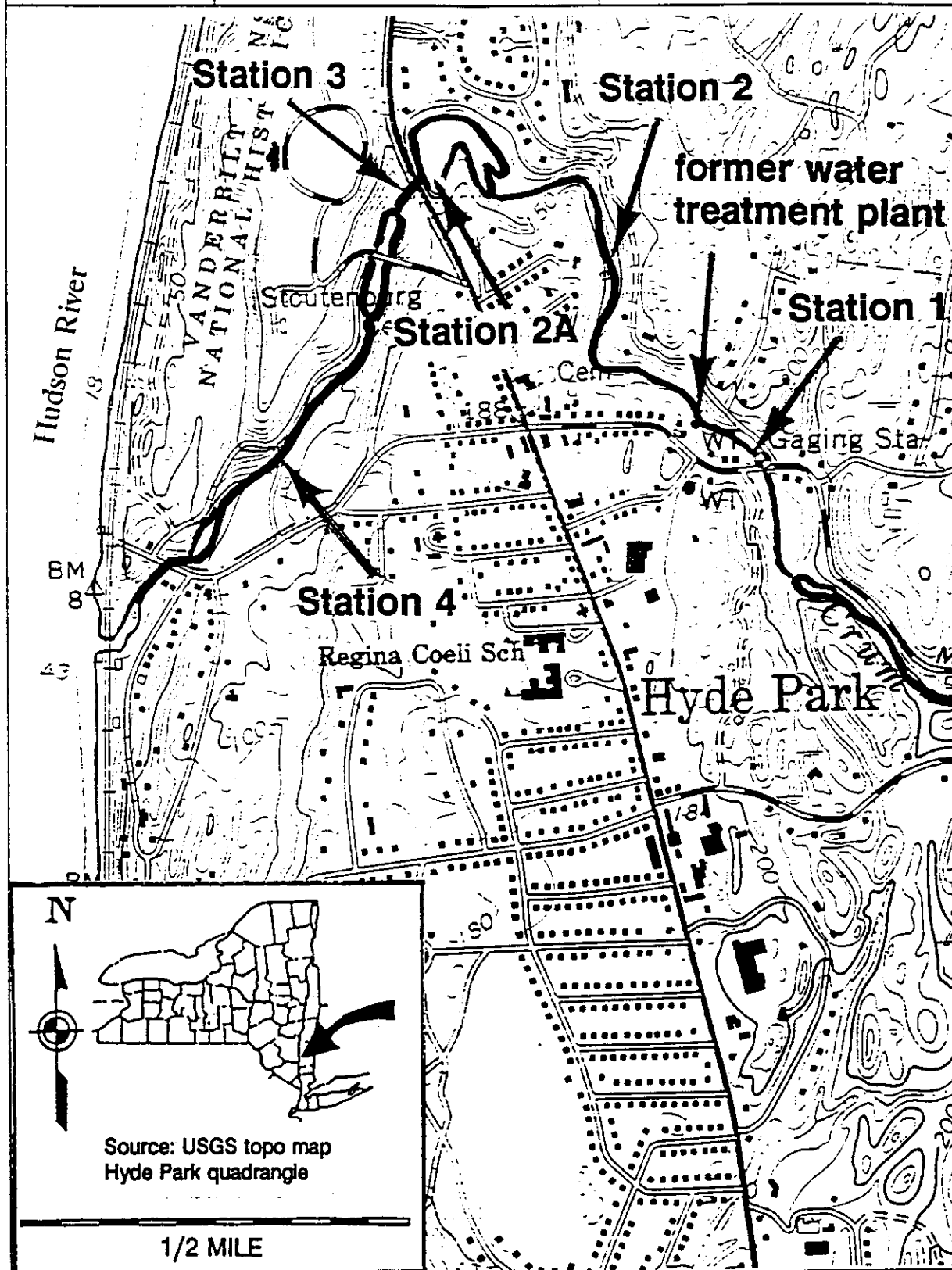


TABLE 2. STATION LOCATIONS FOR THE CRUM ELBOW CREEK, DUTCHESS COUNTY (see map).

<u>STATION</u>	<u>LOCATION</u>
01	Hyde Park 20 m below Market St. bridge; at USGS gage 1.5 miles from the mouth latitude/longitude: 41 47 26; 73 55 51
02	Hyde Park off Howard Blvd.; 0.3 mi. downstream of Sta. 1 1.2 miles from the mouth latitude/longitude: 41 47 37; 73 56 04
02A	Hyde Park immediately east of Rt. 9; edge of pond 0.8 miles from the mouth latitude/longitude: 41 47 44; 73 56 20
03	Hyde Park 30 m below Rt. 9 bridge 0.7 miles from the mouth latitude/longitude: 41 47 44; 73 56 22
04	Hyde Park off Co.Rt. 41; at coach house service rd bridge 0.3 from the mouth latitude/longitude: 41 47 27; 73 56 34

TABLE 3. MACROINVERTEBRATE SPECIES COLLECTED IN CRUM ELBOW CREEK, DUTCHESS COUNTY, NEW YORK, SEPTEMBER 13, 1995.

PLATYHELMINTHES

TURBELLARIA

Undetermined Turbellaria

ANNELIDA

OLIGOCHAETA

Undetermined Lumbricina

Lumbriculidae

Undetermined Lumbriculidae

Tubificidae

Undet. Tubificidae w/o cap. setae

Naididae

Dero sp.

Nais sp.

Stylaria lacustris

HIRUDINEA

Undetermined Hirudinea

MOLLUSCA

GASTROPODA

Physidae

Physella sp.

Hydrobiidae

Undetermined Hydrobiidae

Valvatidae

Undetermined Valvatidae

PELECYPODA

Sphaeriidae

Pisidium sp.

Sphaerium sp.

ARTHROPODA

CRUSTACEA

AMPHIPODA

Gammaridae

Gammarus sp.

INSECTA

EPHEMEROPTERA

Oligoneuriidae

Isonychia bicolor

Baetidae

Baetis flavistriga

Heptageniidae

Stenonema vicarium

Stenonema sp.

Ephemerellidae

Undetermined Ephemerellidae

Caenidae

Caenis sp.

ODONATA

Gomphidae

Undetermined Gomphidae

Coenagrionidae

Undetermined Coenagrionidae

PLECOPTERA

Perlidae

Acroneuria abnormis

Paragnetina media

COLEOPTERA

Psephenidae

Psephenus herricki

Elmidae

Optioservus trivittatus

Optioservus sp.

Oulimnius latiusculus

Stenelmis concinna

Stenelmis sp.

MEGALOPTERA

Corydalidae

Corydalus cornutus

Nigronia serricornis

TRICHOPTERA

Philopotamidae

Chimarra sp.

Polycentropodidae

Neureclipsis sp.

Polycentropus sp.

Hydropsychidae

Cheumatopsyche sp.

Hydropsyche betteni

Hydropsyche morosa

Hydropsyche sp.

Leptoceridae

Leptocerus americanus

DIPTERA

Ceratopogonidae

Undetermined Ceratopogonidae

Chironomidae

Tanypodinae

Labrundinia sp.

Thienemannimyia gr. spp.

TABLE 3 (continued). MACROINVERTEBRATE SPECIES COLLECTED IN CRUM
ELBOW CREEK, DUTCHESS COUNTY, NEW YORK, SEPTEMBER 13, 1995.

Orthocladinae

Cricotopus bicinctus
Cricotopus trifascia gr.
Cricotopus vierriensis
Eukiefferiella brehmi gr.
Parametriocnemus lundbecki
Tvetenia vitracies

Chironominae

Chironomini

Dicrotendipes fumidus
Dicrotendipes modestus
Microtendipes pedellus gr.
Polypedilum aviceps
Polypedilum convictum
Polypedilum illinoense

Tanytarsini

Paratanytarsus confusus
Rheotanytarsus distinctissimus gr.
Rheotanytarsus exiguus gr.
Sublettea coffmani
Tanytarsus guerlus gr.

STREAM SITE: Crum Elbow Creek, Station 1
 LOCATION: Hyde Park, Market Street bridge
 DATE: 13 September 1995
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 individuals

ARTHROPODA

INSECTA

EPHEMEROPTERA	Oligoneuriidae	Isonychia bicolor	12
	Caenidae	Caenis sp.	1
ODONATA	Gomphidae	Undetermined Gomphidae	1
PLECOPTERA	Perlidae	Acroneuria abnormis	8
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Optioservus trivittatus	4
		Stenelmis sp.	24
MEGALOPTERA	Corydalidae	Nigronia serricornis	2
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	10
		Hydropsyche betteni	5
		Hydropsyche sp.	2
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	1
		Cricotopus bicinctus	1
		Cricotopus trifascia gr.	1
		Cricotopus vierriensis	2
		Eukiefferiella brehmi gr.	1
		Parametriocnemus lundbecki	1
		Tvetenia vitracies	1
		Polypedilum aviceps	3
		Polypedilum illinoense	1
		Rheotanytarsus exiguus gr.	16
		Sublettea coffmani	2

SPECIES RICHNESS 22 (good)
 BIOTIC INDEX 4.38 (excellent)
 EPT RICHNESS 6 (good)
 MODEL AFFINITY 61 (good)
 ASSESSMENT slightly impacted

DESCRIPTION The sampling site was downstream of the Market Street bridge, upstream of the former water treatment plant. The invertebrate community included representatives of most major groups, including riffle beetles, mayflies, stoneflies, caddisflies, and hellgrammites. The community type and the water quality indices placed the assessment as slightly impacted, primarily by silt and non-point runoff.

STREAM SITE: Crum Elbow Creek, Station 2
 LOCATION: Hyde Park, off Howard Blvd.
 DATE: 13 September 1995
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 individuals

ANNELIDA			
OLIGOCHAETA		Undetermined Lumbricina	1
	Lumbriculidae	Undetermined Lumbriculidae	2
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Oligoneuriidae	Isonychia bicolor	17
	Baetidae	Baetis flavistriga	1
	Heptageniidae	Stenonema sp.	3
	Caenidae	Caenis sp.	10
ODONATA	Gomphidae	Undetermined Gomphidae	3
PLECOPTERA	Perlidae	Acroneuria abnormis	8
		Paragnetina media	1
COLEOPTERA	Psephenidae	Psephenus herricki	10
	Elmidae	Optioservus trivittatus	7
		Oulimnius latiusculus	1
		Stenelmis concinna	2
MEGALOPTERA	Corydalidae	Corydalus cornutus	1
		Nigronia serricornis	6
TRICHOPTERA	Polycentropodidae	Polycentropus sp.	1
	Hydropsychidae	Cheumatopsyche sp.	7
		Hydropsyche betteni	4
		Hydropsyche morosa	1
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	1
		Cricotopus vierriensis	3
		Microtendipes pedellus gr.	2
		Polypedilum aviceps	1
		Polypedilum convictum	3
		Paratanytarsus confusus	1
		Rheotanytarsus exiguus gr.	1
		Sublettea coffmani	1
		Tanytarsus guerlus gr.	1
SPECIES RICHNESS		28 (excellent)	
BIOTIC INDEX		3.96 (excellent)	
EPT RICHNESS		10 (good)	
MODEL AFFINITY		83 (excellent)	
ASSESSMENT		non-impacted	

DESCRIPTION The sample was taken down the embankment from Howard Boulevard, approximately 0.25 miles downstream of the former water treatment plant. Although the stream was quite slow and shallow, a diverse invertebrate community was found, with representatives of most major groups. The community type was indicated to be natural, and water quality was assessed as non-impacted.

STREAM SITE: Crum Elbow Creek, Station 3
 LOCATION: Hyde Park, below Route 9
 DATE: 13 September 1995
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	1
MOLLUSCA			
PELECYPODA	Sphaeriidae	Pisidium sp.	2
		Sphaerium sp.	23
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Oligoneuriidae	Isonychia bicolor	12
	Baetidae	Baetis flavistriga	1
	Heptageniidae	Stenonema vicarium	3
		Stenonema sp.	3
	Ephemerellidae	Undetermined Ephemerellidae	1
	Caenidae	Caenis sp.	1
PLECOPTERA	Perlidae	Acroneuria abnormis	1
COLEOPTERA	Psephenidae	Psephenus herricki	1
	Elmidae	Stenelmis sp.	4
TRICHOPTERA	Philopotamidae	Chimarra sp.	1
	Polycentropodidae	Neureclipsis sp.	2
		Polycentropus sp.	1
	Hydropsychidae	Cheumatopsyche sp.	11
		Hydropsyche betteni	10
DIPTERA	Chironomidae	Thienemannimyia gr. spp.	1
		Microtendipes pedellus gr.	1
		Polypedilum aviceps	1
		Polypedilum convictum	4
		Rheotanytarsus distinct. gr.	1
		Rheotanytarsus exiguus gr.	11
		Tanytarsus guerlus gr.	3
SPECIES RICHNESS	24 (good)		
BIOTIC INDEX	5.03 (good)		
EPT RICHNESS	12 (excellent)		
MODEL AFFINITY	67 (excellent)		
ASSESSMENT	slightly impacted		

DESCRIPTION The kick sample was taken about 30 meters downstream of Route 9. Just upstream was a 2 meter high falls, and the bottom substrate was quite rocky. Mayflies, caddisflies, stoneflies, and hellgrammites were obtained, and no water quality problems were indicated. Water quality was assessed as slightly impacted, based on the metrics, but this is probably due to effects of the impoundment upstream of Route 9.

STREAM SITE: Crum Elbow Creek, Station 4
 LOCATION: Hyde Park, coach house service road
 DATE: 13 September 1995
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 individuals

MOLLUSCA			
PELECYPODA	Sphaeriidae	Sphaerium sp.	40
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Oligoneuriidae	Isonychia bicolor	2
	Heptageniidae	Stenonema vicarium	1
		Stenonema sp.	1
	Ephemerellidae	Undetermined Ephemerellidae	2
PLECOPTERA	Perlidae	Acroneuria abnormis	4
COLEOPTERA	Elmidae	Optioservus sp.	2
		Oulimnius latiusculus	1
		Stenelmis concinna	21
MEGALOPTERA	Corydalidae	Corydalis cornutus	1
TRICHOPTERA	Philopotamidae	Chimarra sp.	9
	Hydropsychidae	Cheumatopsyche sp.	6
		Hydropsyche betteni	2
		Hydropsyche sp.	2
DIPTERA	Chironomidae	Polypedilum aviceps	4
		Polypedilum convictum	2

SPECIES RICHNESS 16 (fair)
 BIOTIC INDEX 4.96 (good)
 EPT RICHNESS 9 (good)
 MODEL AFFINITY 46 (fair)
 ASSESSMENT slightly impacted

DESCRIPTION The kick sample was taken under the bridge of the service road to the Vanderbilt Mansion coach house. The habitat was ravine-like, with the stream narrowed and the bottom dominated by bedrock. The kick sample was taken in pockets of rubble, and this was considered to have a limiting effect on the invertebrate fauna. The sample was dominated by fingernail clams, although mayflies, stoneflies, caddisflies, and hellgrammites were present. In the original sorting of this sample, fingernail clams (*Sphaerium* sp.) comprised 51% of the sample. Since species dominance exceeding 40% of the total sample has been found to result in skewed metrics and non-representative assessments, this species was limited to 40% to produce more valid results. Using this limit, most metrics were still somewhat depressed, and overall water quality was in the slightly impacted range. However, no worsening of water quality from Station 3 was indicated.

STREAM SITE: Crum Elbow Creek, Station 2A
 LOCATION: Hyde Park, pond above Route 9
 DATE: 13 September 1995
 SAMPLE TYPE: Kick sample
 SUBSAMPLE: 100 individuals

PLATYHELMINTHES		Undetermined Turbellaria	25
ANNELIDA			
OLIGOCHAETA	Tubificidae	Undet. Tubificidae w/o cap.setae	1
	Naididae	Dero sp.	1
		Nais sp.	1
		Stylaria lacustris	5
HIRUDINEA		Undetermined Hirudinea	1
MOLLUSCA			
GASTROPODA	Physidae	Physella sp.	3
	Hydrobiidae	Undetermined Hydrobiidae	3
	Valvatidae	Undetermined Valvatidae	3
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	Gammarus sp.	26
INSECTA			
ODONATA	Coenagrionidae	Undetermined Coenagrionidae	4
TRICHOPTERA	Polycentropodidae	Polycentropus sp.	1
	Leptoceridae	Leptocerus americanus	2
	Ceratopogonidae	Undetermined Ceratopogonidae	6
DIPTERA	Chironomidae	Labrundinia sp.	1
		Cricotopus vierriensis	3
		Dicrotendipes fumidus	1
		Dicrotendipes modestus	1
		Paratanytarsus confusus	5
		Tanytarsus guerlus gr.	7

SPECIES RICHNESS 20 (good) Ponar criteria
 BIOTIC INDEX 6.51 (excellent) Ponar criteria
 SPECIES DIVERSITY 3.39 (excellent) Ponar criteria
 MODEL AFFINITY 63 (good) Ponar criteria
 ASSESSMENT non-impacted

DESCRIPTION This sample was a net sample taken from the ponded part of the stream just above Route 9. The sample was composed mostly of mud and macrophytes, and supported many species of invertebrates typically found in ponds. Dominant organisms were scuds, flatworms, and midges; caddisflies and damselfly larvae were also found. Ponar criteria were used to evaluate the sample, and the assessment using these criteria was non- to slightly impacted.

LABORATORY DATA SUMMARY

STREAM NAME Crum Elbow Creek
DATE SAMPLED 09/13/95
SAMPLING METHOD Traveling kick

DRAINAGE 13
COUNTY Dutchess

STATION	01	02	03	04
LOCATION	Market St. USGS gage	Howard Blvd.	Rt. 9 bridge	coach house road
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME				
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere in this report. Intolerant = not tolerant of poor water quality; Facultative = occurring over a wide range of water quality; Tolerant = tolerant of poor water quality.	1. Stenelmis sp. 24 facultative beetle	Isonychia bicolor 17 intolerant mayfly	Sphaerium sp. 23 facultative clam	Sphaerium sp. 40 facultative clam
	2. Rheotany exiguus 16 facultative midge	Caenis sp. 10 facultative mayfly	Isonychia bicolor 12 intolerant mayfly	Stenelmis concinna 21 facultative beetle
	3. Isonychia bicolor 12 intolerant mayfly	Psephenus herricki 10 intolerant beetle	Cheumatopsy sp. 11 facultative caddisfly	Chimmara sp. 9 intolerant caddisfly
	4. Cheumatopsy sp. 10 facultative caddisfly	Acroneuria abnormis 8 intolerant stonefly	Rheotany exiguus 11 facultative midge	Cheumatopsy sp. 6 facultative caddisfly
	5. Acroneuria abnormis 8 intolerant stonefly	Cheumatopsy sp. 7 facultative caddisfly	Hydropsyche betteni 10 facultative caddisfly	Polypedilum aviceps 4 facultative midge
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	30 (11)	14 (9)	22 (7)	6 (2)
Trichoptera (caddisflies)	17 (3)	13 (4)	25 (5)	19 (4)
Ephemeroptera (mayflies)	13 (2)	31 (4)	21 (6)	6 (4)
Plecoptera (stoneflies)	8 (1)	9 (2)	1 (1)	4 (1)
Coleoptera (beetles)	29 (3)	20 (4)	5 (2)	24 (3)
Oligochaeta (worms)	0 (0)	3 (2)	0 (0)	0 (0)
Others (**)	3 (2)	10 (3)	26 (3)	41 (2)
TOTAL	100 (22)	100 (28)	100 (24)	100 (16)
SPECIES RICHNESS	22	28	24	16
HBI INDEX	4.38	3.96	5.03	4.96
EPT VALUE	6	10	12	9
PMA VALUE	61	83	67	46
FIELD ASSESSMENT	no impact	no impact	no impact	no impact
OVERALL ASSESSMENT	slightly impacted	non-impacted	slightly impacted	slightly impacted

** fingernail clams, hellgrammites, dragonflies

LABORATORY DATA SUMMARY

STREAM NAME Crum Elbow Creek
DATE SAMPLED 09/13/95
SAMPLING METHOD Net jab

DRAINAGE 13
COUNTY Dutchess

STATION	02A			
LOCATION	pond above Rt. 9			
DOMINANT SPECIES\% CONTRIBUTION\TOLERANCE\COMMON NAME				
Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere in this report. Intolerant = not tolerant of poor water quality; Facultative = occurring over a wide range of water quality; Tolerant = tolerant of poor water quality.	1.	Gammarus sp. 26 facultative scud		
	2.	Undeterm. Turbell 25 facultative flatworm		
	3.	Tanytarsus guerlus 7 facultative midge		
	4.	Undeterm. Ceratopo 6 facultative punkie		
	5.	Stylaria lacust 5 tolerant worm		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	18	(6)		
Trichoptera (caddisflies)	3	(2)		
Ephemeroptera (mayflies)	0	(0)		
Plecoptera (stoneflies)	0	(0)		
Coleoptera (beetles)	0	(0)		
Oligochaeta (worms)	8	(4)		
Others (**)	71	(8)		
TOTAL	100	(20)		
SPECIES RICHNESS	20			
HBI INDEX	6.51			
SPECIES DIVERSITY	3.39			
PMA VALUE	36			
FIELD ASSESSMENT	-			
OVERALL ASSESSMENT	non-impacted			

** flatworms, snails, scuds

FIELD DATA SUMMARY SHEET

STREAM NAME: Crum Elbow Creek

REACH: vicinity of Hyde Park

DATE SAMPLED: 09-13-95

FIELD PERSONNEL INVOLVED: Abele, Bode, Sansalone

STATION	01	02	03	04
ARRIVAL TIME AT STATION	10:40	11:15	12:05	12:35
LOCATION	Market St USGS gage	Howard Blvd.	below Rt. 9	coach house rd.
PHYSICAL CHARACTERISTICS				
Width (meters)	5	10	10	2
Depth (meters)	0.1	0.1	0.2	0.2
Current speed (cm per sec)	50	45	56	80
Substrate (%)				
rock (> 10 in. or bedrock)	10	20	20	20
rubble (2.5-10 in.)	50	50	50	50
gravel (0.08-2.5 in.)	20	10	10	10
sand (0.06-2.0 mm)	10	10	10	10
silt (0.004-0.06 mm)	10	10	10	10
clay (less than 0.004 mm)				
Embeddedness (%)	20	20	20	20
CHEMICAL MEASUREMENTS				
Temperature (oC)	16.5	16.3	16.4	17.6
Specific conductance (umhos)	550	516	555	573
Dissolved Oxygen (mg per l)	8.3	8.0	7.9	8.9
pH	8.0	8.0	8.1	8.3
BIOLOGICAL ATTRIBUTES				
Canopy (%)	50	90	40	70
Aquatic Vegetation				
algae - water column				
algae - filamentous	present		present	
algae - diatoms				
macrophytes; moss				
Occurrence of Macroinvertebrates				
Chironomidae (midges)	X		X	
Trichoptera (caddisflies)		X	X	
Ephemeroptera (mayflies)	X	X	X	
Plecoptera (stoneflies)	X	X	X	X
Coleoptera (beetles)	X			
Oligochaeta (worms)				
Other (**)	X	X	X	X
ESTIMATED BIOMASS	medium	medium	medium	medium
FIELD ESTIMATE OF WATER QUALITY	non	non	non	non
FIELD COMMENTS				

** crayfish, hellgrammites

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 water. 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 pollution tolerance of the organisms in the sample. 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). 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 (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.

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.

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.

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; EPT richness is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

2. Slightly impacted

Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness usually is 19-26. Mayflies and stoneflies may be restricted, with EPT richnesses 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

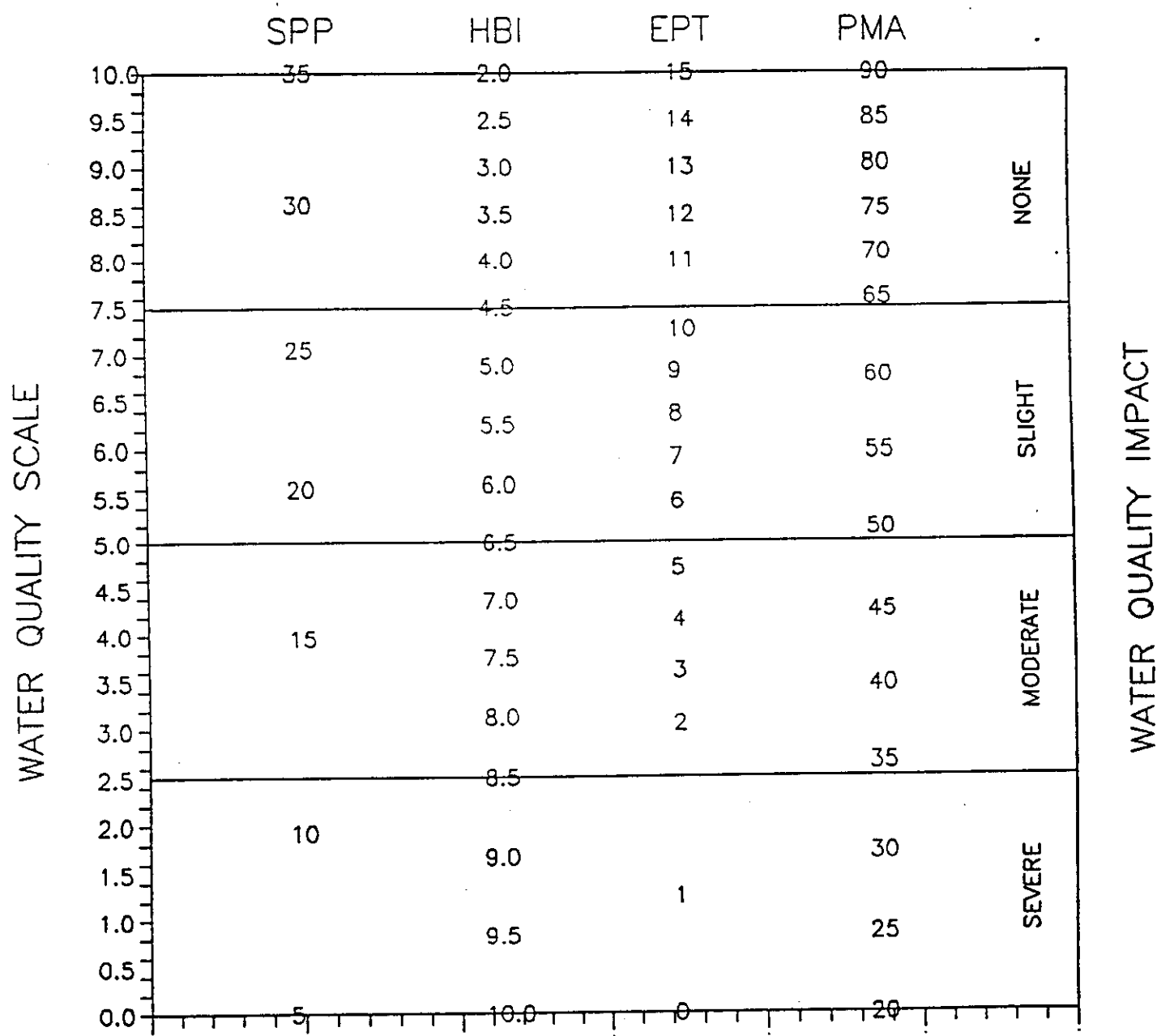
Indices reflect fair water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness usually is 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 2-5. The biotic index value is 6.51 to 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 richness is 0-1. The biotic index value is 8.51 or greater. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

Appendix IV. BIOLOGICAL ASSESSMENT PROFILE OF INDEX VALUES

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



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

Appendix V

WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

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

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

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

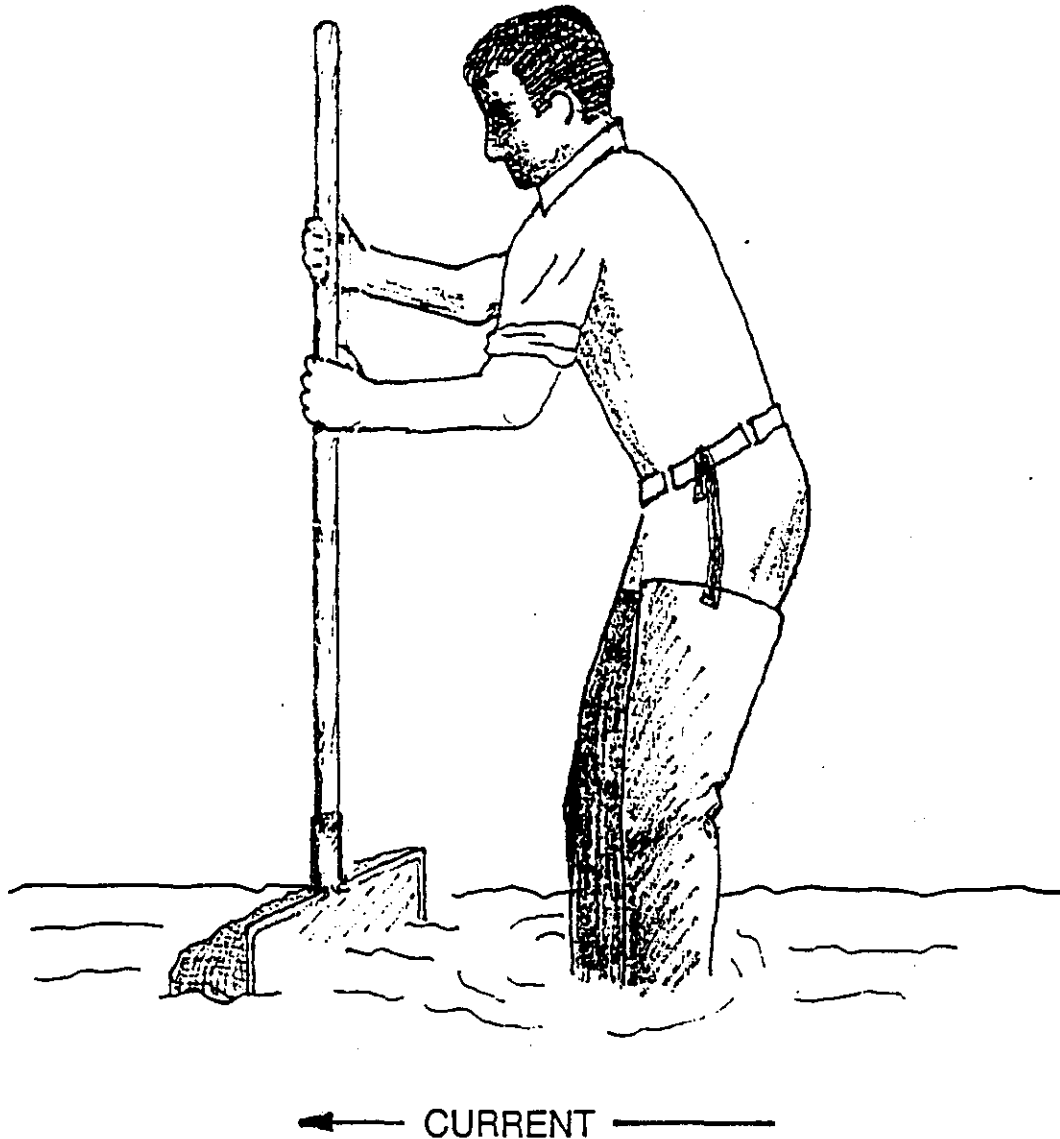
WATER QUALITY ASSESSMENT CRITERIA

for navigable flowing waters

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

Appendix VI.

THE TRAVELING KICK SAMPLE

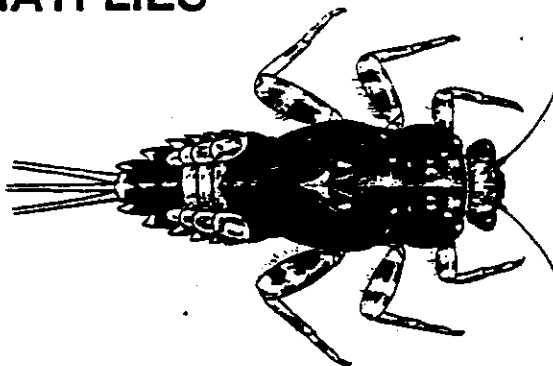


Rocks and sediment in the stream riffle are dislodged by foot upstream of a net; dislodged organisms are carried by the current in the net. Sampling is continued for a specified time, gradually moving downstream to cover a specified distance.

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE GOOD WATER QUALITY

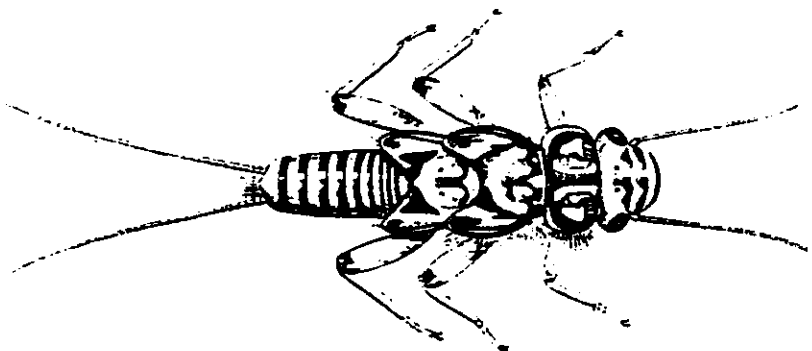
Mayfly nymphs are often the most numerous organisms found in clean streams. They are sensitive to most types of pollution, including low dissolved oxygen (less than 5 ppm), chlorine, ammonia, metals, pesticides, and acidity. Most mayflies are found clinging to the undersides of rocks.

MAYFLIES



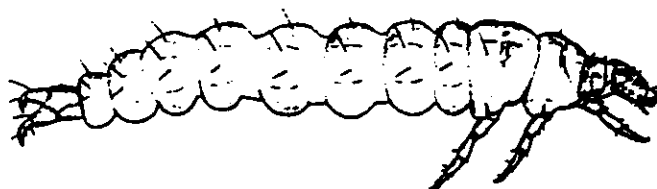
Stonefly nymphs are mostly limited to cool, well-oxygenated streams. They are sensitive to most of the same pollutants as mayflies except acidity. They are usually much less numerous than mayflies. The presence of even a few stoneflies in a stream suggests that good water quality has been maintained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

STONEFLIES



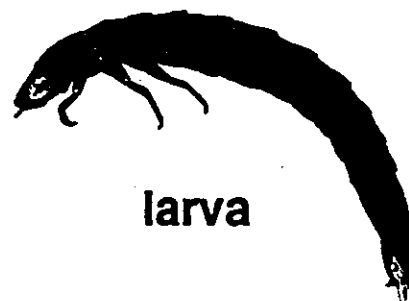
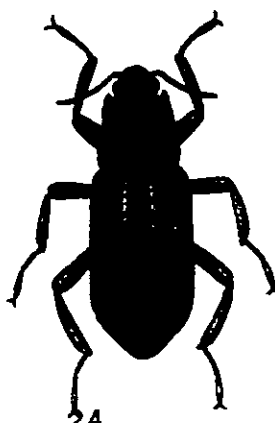
Caddisfly larvae often build a portable case of sand, stones, sticks, or other debris. Many caddisfly larvae are sensitive to pollution, although a few are tolerant. One family spins nets to catch drifting plankton, and is often numerous in recovery zones below sewage discharges.

CADDISFLIES



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

BEETLES



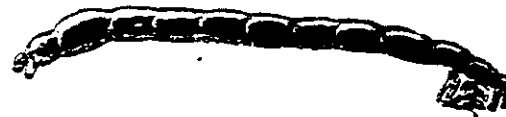
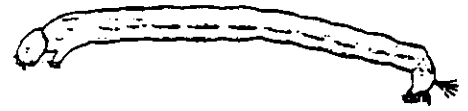
larva

adult

AQUATIC MACROINVERTEBRATES THAT USUALLY INDICATE POOR WATER QUALITY

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

MIDGES



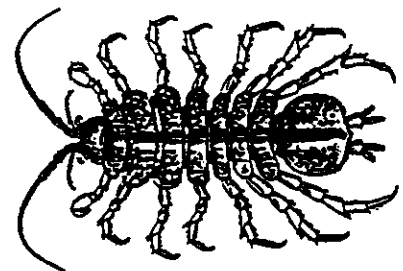
The segmented worms include the leeches and the small aquatic earthworms. The latter are more common, though usually unnoticed. They burrow in the substrate and feed on bacteria in the sediment. They can thrive under conditions of severe pollution and very low oxygen levels, and are thus valuable pollution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

WORMS



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

SOWBUGS



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.

BLACK FLIES



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

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

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. Most invertebrate-based determinations are able to distinguish toxic stress from organic stress, but little progress has been made beyond this level. The Ohio Department of Environmental Protection recently proposed the use of Biological Response Signatures to identify pollutant types, based on patterns of 12 metrics of fish and invertebrate communities (Yoder and Rankin, 1995). We tested metric patterns for communities from streams in New York State, but no consistent patterns emerged.

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

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

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

APPENDIX X, cont. Models of community types for Impact Source Determination.

	NATURAL					NPS AGRICULTURE						TOXIC			
	A	B	C	D	E	A	B	C	D	E	F	A	B	C	D
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	-	-	20	-	-	-	10	20	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	10	10	-	20
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
<u>Isonychia</u>	5	5	-	5	20	-	-	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	15	20	10	20	10	15	10	20	-
HEPTAGENIIDAE	5	10	5	20	10	-	-	-	-	5	5	-	-	-	-
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	5	5	5	10	-	-	-	-	10	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	5	-	-	-	-	5	-	-	-	-	5	-	-	-	-
<u>Optioservus</u>	5	-	20	5	5	10	-	10	10	-	-	-	-	-	-
<u>Promoresia</u>	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	10	5	10	10	5	15	15	-	-	15	5	10	15	-	40
PHILOPOTAMIDAE	5	20	5	5	5	15	5	-	-	-	25	10	-	-	-
HYDROPSYCHIDAE	10	5	15	15	10	15	-	15	-	10	35	20	10	15	10
<u>Cheumatopsyche</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Hydropsyche</u>	-	-	-	-	-	-	15	-	10	-	-	-	-	-	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	5	5	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	5	5	5	-	15	5	5	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tanypodinae	-	5	-	-	-	-	-	-	-	-	-	5	10	-	-
<u>Cardiocladius</u>	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Orthocladius</u>	5	5	-	-	10	10	15	10	5	-	-	15	10	25	10
<u>Eukiefferiella/</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Tvetenia</u>	5	5	10	-	-	-	15	10	-	-	-	-	-	20	10
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u>	5	5	5	5	5	10	10	10	10	20	10	10	-	-	-
Tanytarsini	-	5	10	5	5	10	10	10	20	20	5	-	-	-	-
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

APPENDIX X, cont. Models of community types for Impact Source Determination.

	CONVENTIONAL MUNICIPAL								SEWAGE/TOXICS				
	A	B	C	D	E	F	G	H	A	B	C	D	E
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	40	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	20	70	10	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	5	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	10	5	10	10	15
GAMMARIDAE	-	-	-	-	-	10	-	10	40	-	-	-	15
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-	-	-	5
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	5	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Optioservus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	15	-	10	10	-	-	-	-	5	-	-	10	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	-	-	10	-	10	-	-	10	10	-	-	50	20
<u>Cheumatopsyche</u>	25	-	-	10	-	-	-	-	-	-	-	-	-
<u>Hydropsyche</u>	20	-	-	-	-	-	-	-	-	-	-	-	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	25	10	35	-	-	-	-	-	-	-
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	5	-	-	-
Tanypodinae	-	5	-	-	-	-	-	-	-	10	-	-	5
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/</u> <u>Orthocladius</u>	-	10	15	-	-	10	10	-	5	10	20	-	5
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	10	-	-	-	-	-	-	-	-	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	10	-	-	-	-	-	-
<u>Polypedilum</u>	10	10	10	10	60	-	30	10	-	-	-	10	20
Tanytarsini	10	10	10	10	-	-	-	10	-	-	-	10	10
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

APPENDIX X, cont. Models of community types for Impact Source Determination.

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Caenis/Tricorythodes</u>	5	20	10	5	15	-	-	-	-	-	-	-	-	-	
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Optioservus</u>	5	10	-	-	-	-	-	-	-	-	-	-	-	5	
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Stenelmis</u>	5	10	10	5	20	5	5	10	10	-	5	35	-	5	
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	
<u>Cheumatopsyche</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Hydropsyche</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	
<u>Simulium vittatum</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Cricotopus/</u> <u>Orthocladius</u>	25	-	10	5	5	5	25	5	-	10	-	5	10	-	
<u>Eukiefferiella/</u> <u>Tvetenia</u>	-	-	10	-	5	5	15	-	-	-	-	-	-	-	
<u>Parametrioctenemus</u>	-	-	-	-	-	5	-	-	-	-	-	-	-	-	
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<u>Polypedilum</u>	10	10	10	5	5	5	-	-	20	-	-	5	5	5	
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

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