New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Carmans River

Biological Assessment

2008 Survey

New York State
Department of Environmental Conservation

BIOLOGICAL STREAM ASSESSMENT

Carmans River
Suffolk County, New York
Atlantic Ocean – Long Island Basin

Survey date: September 10, 2008
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Table of Contents

Stream: Carmans River

River Basin: Atlantic Ocean – Long Island

Reach: East Bartlett Road above Yaphank to DEC fishing access in South Haven, NY

Background

The Stream Biomonitoring Unit sampled five stations on the Carmans River in the reach between Yaphank and South Haven, Suffolk County, New York, on September 10, 2008. Sampling was conducted to assess general water quality, and compare results to those of previous surveys. The current survey focused on sampling the freshwater portion of the Carmans River, Stations 1-4, and Station E.

To characterize water quality based on benthic macroinvertebrate communities, a traveling kick sample was collected from riffle areas at each of the five sites on the Carmans River. Methods used are described in the Quality Assurance document (Bode et al, 2002) and summarized in Appendix I. The contents of each sample were field-inspected to determine major groups of organisms present, and then preserved in alcohol for laboratory inspection of 100-specimen subsamples from each site.

Macroinvertebrate community parameters used in the determination of water quality included: species richness, biotic index, EPT richness, and NCO richness (see Appendices II and III). Amount of expected variability of results is stated in Smith and Bode (2004). Table 3 provides a listing of sampling sites, and Table 5 provides a listing of all species collected in the present survey. This is followed by macroinvertebrate data reports, including raw data from each site.

Results and Conclusions

1. Water quality ranged from slightly to moderately impacted at each of the five stations on the Carmans River (Figure 1). Water quality improved at Stations 1 and 2 compared to the previous survey of the Carmans River (Bode et al, 1989), while Stations 3 and 4 decreased in water quality (Figure 1a).

2. Conductivity values have increased significantly since 1989, 75-90 (umhom/cm) greater at each site (Table 2). This may have been a contributing factor to the decreased water quality assessments at the downstream sites and suggests that septic releases and additional road de-icing may be impacting water quality. While levels are still relatively low, future studies should monitor possible increases in this water quality parameter.

3. Based on both the invertebrate community and chemical data from both water and sediment, there has been no evidence to date that contaminant groundwater plumes have reached the river. The decrease in water quality at Stations 3 and 4 may be due to any number of factors, including habitat restrictions (the substrate consists mostly of sand and gravel), high nutrient loads, and increased conductivity values.

Discussion

The Carmans River originates in the central part of Long Island, near Route 25 in Middle Island, and flows south about 10 miles to its mouth in Bellport Bay. It is fresh water for the first eight miles and then becomes tidal for the remaining two miles. It is one of the four largest rivers on Long Island and, similar to other Long Island rivers, is primarily (95%) groundwater generated. There are four dams on the upper river at Upper Mill Pond, Lower Mill Pond, Southaven Park, and the Sunrise Highway.

The Carmans River is an important trout habitat and the fresh surface water portion of the river is classified as C (TS) (trout-spawning). Southaven County Park encompasses upstream parts of the river and allows for special regulation trout fishing. Recreational fishing for brook trout, brown trout, and yellow perch attracts anglers from across Long Island.

It was designated by New York State as a Wild, Scenic and Recreational River in 1972. Below the Sunrise Highway, the river widens, becomes tidal, and is bordered on both sides by extensive salt marsh, much of which is in the Wertheim National Wildlife Refuge. This refuge was primarily established to protect the Carmans River Estuary for migratory birds.

Duck farming was a major agricultural component on the western shores of the Carmans River adjacent to the Wertheim National Wildlife Refuge up until the early 1980s when the majority of these facilities closed due to the enforcement of stringent pollution control requirements, reducing their contribution of nonpoint source runoff to the river. While these farms have been gone for decades, we cannot rule out the possibility that these past agricultural practices may have contributed contaminants to the river.

There is also local concern about whether contaminated groundwater in the drainage area is affecting the water quality of the Carmans River. A Federal Superfund site (Brookhaven National Laboratory), Voluntary Cleanup Program site (Long Island Railroad at Yaphank), and landfill leachate plume (Town of Brookhaven) have added contaminants to the groundwater in the drainage area of the Carmans River. So far, the data collected show that the identified contaminant plumes in the Carmans River drainage area have impacted groundwater quality, but not significantly impacted the river. This situation should continue to be monitored, as these contaminants may eventually reach the river.

Biological Assessment of Water Quality:

On September 10, 2008, macroinvertebrate samples were collected at each of five sites on the Carmans River in Suffolk County, NY. This data was collected to assess overall water quality information in this area, which has not been compiled since 1989 (Bode et al, 1989). The 1989 study concluded that, due to the warm-water nature of the river, macroinvertebrate "communities present probably represented the best condition of the river."

Biological Assessment Profile (BAP) scores indicate conditions ranging from slightly to moderately impacted (Figure 1) (Bode et al 2002). Resident macroinvertebrate communities at all sites were dominated by scuds, sowbugs or flatworms (Table 6). Most of these impacts are probably due to the low gradient habitat of the river, its warm-water character, and the large amount of aquatic vegetation present at all sites.

Nutrients appear to be one of the major factors determining water quality in the stream. The Nutrient Biotic Index (NBI) (Smith et al. 2007) suggests eutrophic conditions resulting from excess phosphorus (NBI-P) and nitrogen (NBI-N) (Figure 4) at all sites except Station 1. These excess nutrient loads could be the natural state for this river, given its high volume of aquatic vegetation, low gradient habitat and warm-water.

Impact Source Determination (ISD) identified sewage (CARM-01) and municipal/industrial inputs (CARM -02 and CARM-04), as the source of water-quality impacts at these sites (Table 3). The population along the Carmans River corridor has increased by approximately 50 percent in the past 20 years, with associated increases in private and municipal wastewater discharges, effects from larger areas of impervious surfaces in the watershed, and changing land uses. However, since much of the river flows through parks and preserves, any measurable water quality changes to date have been kept to a minimum. Any future development proposed along the Carmans River corridor should be evaluated for possible detrimental impacts to the drainage area, including increased nitrogen loading.

Literature Cited

Bode, R. W., M. A. Novak, L. E. Abele. 1989. Biological Stream Assessment of Carmans River, Suffolk County, New York. New York State Department of Environmental Conservation, Technical Report, 27 pages.

Bode, R. W., M. A. Novak, L. E. Abele, D. L. Heitzman, and A. J. Smith. 2002. Quality Assurance Work Plan for Biological Stream Monitoring in New York State. New York State Department of Environmental Conservation, Technical Report, 115 pages.

Suffolk County Department of Health Services. 2002. Carmans River Environmental Assessment, Town of Brookhaven, Suffolk County, New York. SCDHS, Hauppauge, NY. 135 pages.

Smith, A. J., and R. W. Bode. 2004. Analysis of Variability in New York State Benthic Macroinvertebrate Samples. New York State Department of Environmental Conservation, Technical Report, 43 pages.

Smith, A.J., R. W. Bode, and G. S. Kleppel. 2007. A Nutrient Biotic Index for Use with Benthic Macroinvertebrate Communities. Ecological Indicators 7(200):371-386.

Figure 1. Biological Assessment Profile (BAP) of index values for samples from slow, sandy streams, Carmans River, Suffolk County, 2008. Values are plotted on a normalized scale of water quality. The BAP represents the mean of the four values for each site, representing species richness (Spp), EPT richness, Hilsenhoff Biotic Index (HBI), and Non Chironomidae, Oligochaeta (NCO) richness. See Appendix IV for a more complete explanation.

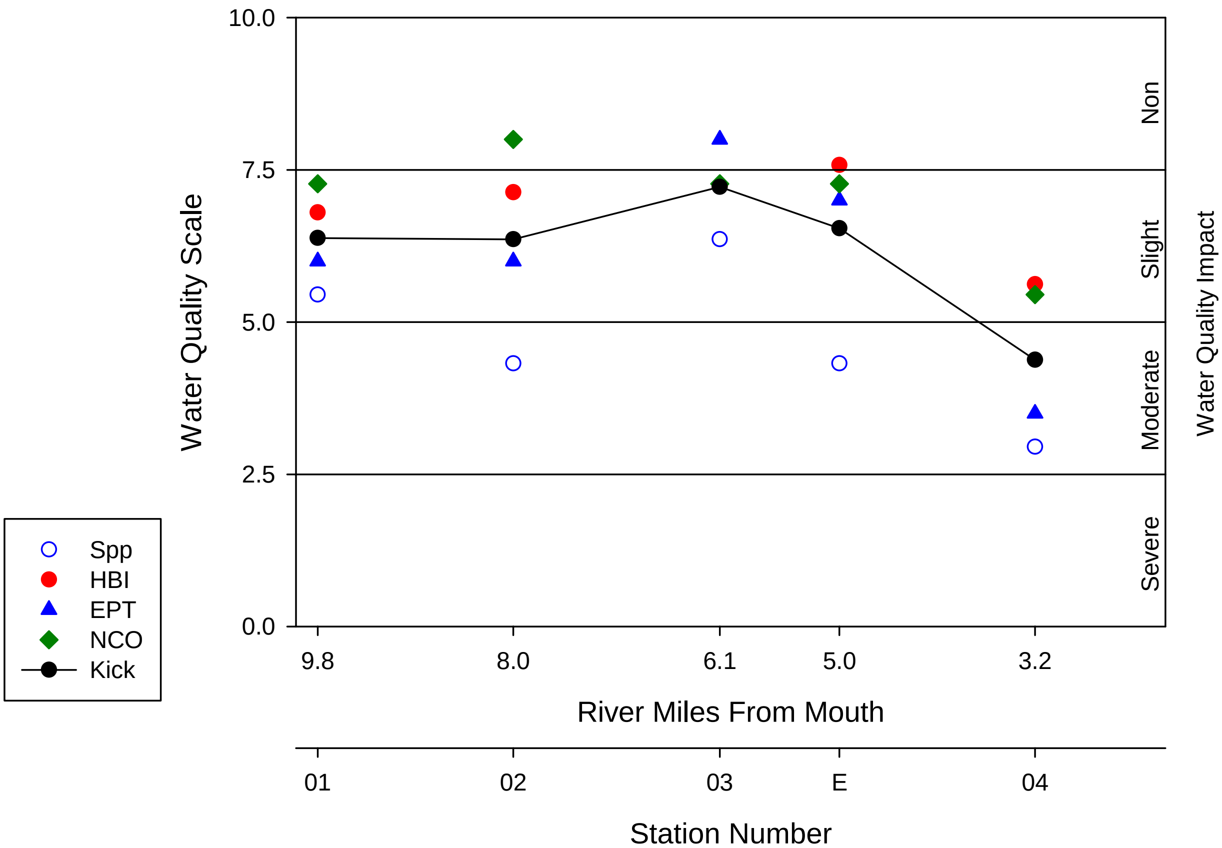


Figure 1a. Biological Assessment Profile (BAP) of index values for samples from slow, sandy streams, Carmans River, Suffolk County, 1989 and 2008.

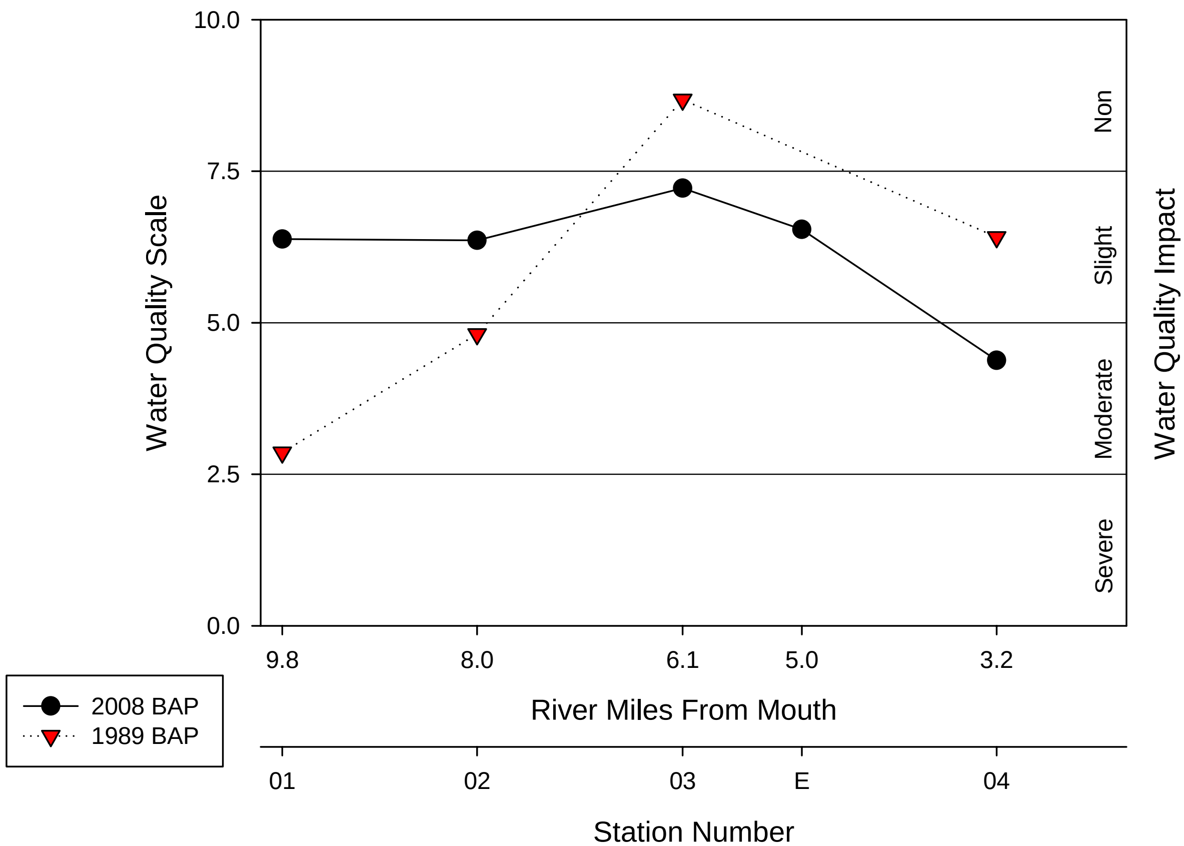


Table 1. Overview of Field Data

Location	Station	Depth (meters)	Width (meters)	Current (cm/sec)	Canopy (%)	Embedd (%)	Temp (˚C)	Cond. (umhom/cm)	pH (units)	DO (mg/l)
CARM	01	<0.1	2	50	90	40	17.8	161	7.4	7.7
CARM	02	0.2	8	71	50	30	20.9	157	7.4	8.5
CARM	03	0.2	15	100	10	30	19.5	171	7.3	9.9
CARM	E	0.4	20	59	10	20	19.5	193	7.6	13.3
CARM	04	0.4	25	42	25	50	19.7	189	7.4	9.6

Table 2. Conductivity Values 1989 and 2008

Location	Station	1989 Cond. (umhom/cm)	2008 Cond. (umhom/cm)
CARM	01	-	161
CARM	02	70	157
CARM	03	95	171
CARM	E	-	193
CARM	04	110	189

Table 3. Station Locations for the Carmans River, Suffolk County, New York, 2008.

Station	Location	
CARM-01	Above Yaphank, NY Below East Bartlett Road River Mile: 9.8 Latitude: 40.8633 Longitude: -72.9425	
CARM-02	Siegfield Park, NY Below Upper Lake River Mile: 8.0 Latitude: 40.8415 Longitude: -72.9365	
CARM-03	Below Yaphank, NY 10 m below foot bridge at USGS gaging station River Mile: 6.1 Latitude: 40.82991 Longitude: -72.90599	

Table 3a. Station Locations for the Carmans River, Suffolk County, New York, 2008.

Station	Location	
CARM-E	Yaphank, NY South Haven Park, fishing access E Gate, Site #5 River Mile: 5.0 Latitude: 40.82375 Longitude: -72.89200	
CARM-04	South Haven, NY CR 80 at bridge, near DEC fishing access River Mile: 3.2 Latitude: 40.80126 Longitude: -72.88371	

Figure 2. Overview Map, Carmans River, Suffolk County.

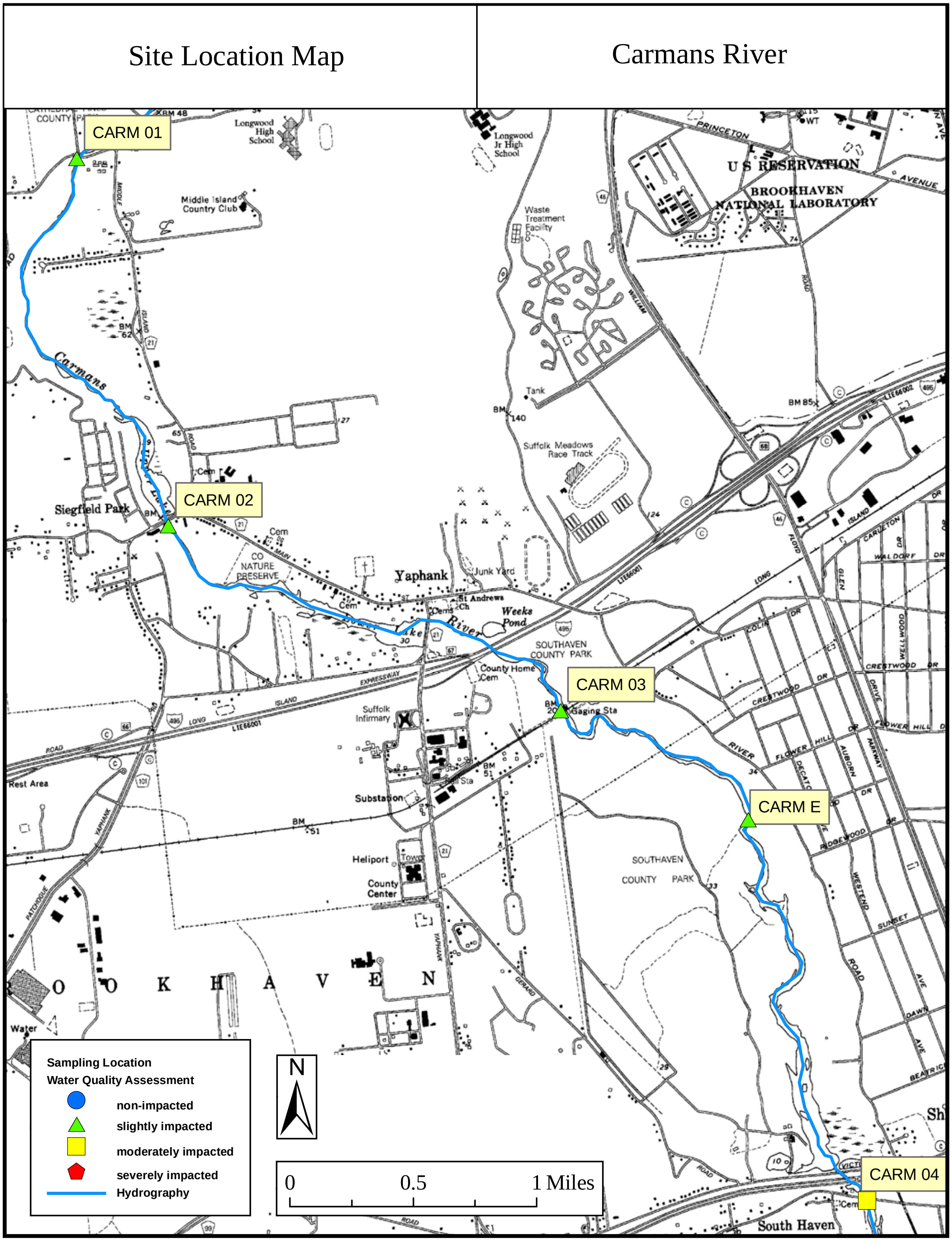


Figure 3. Site Location Map, Carmans River, Station 01

Site Location Map	Carmans River

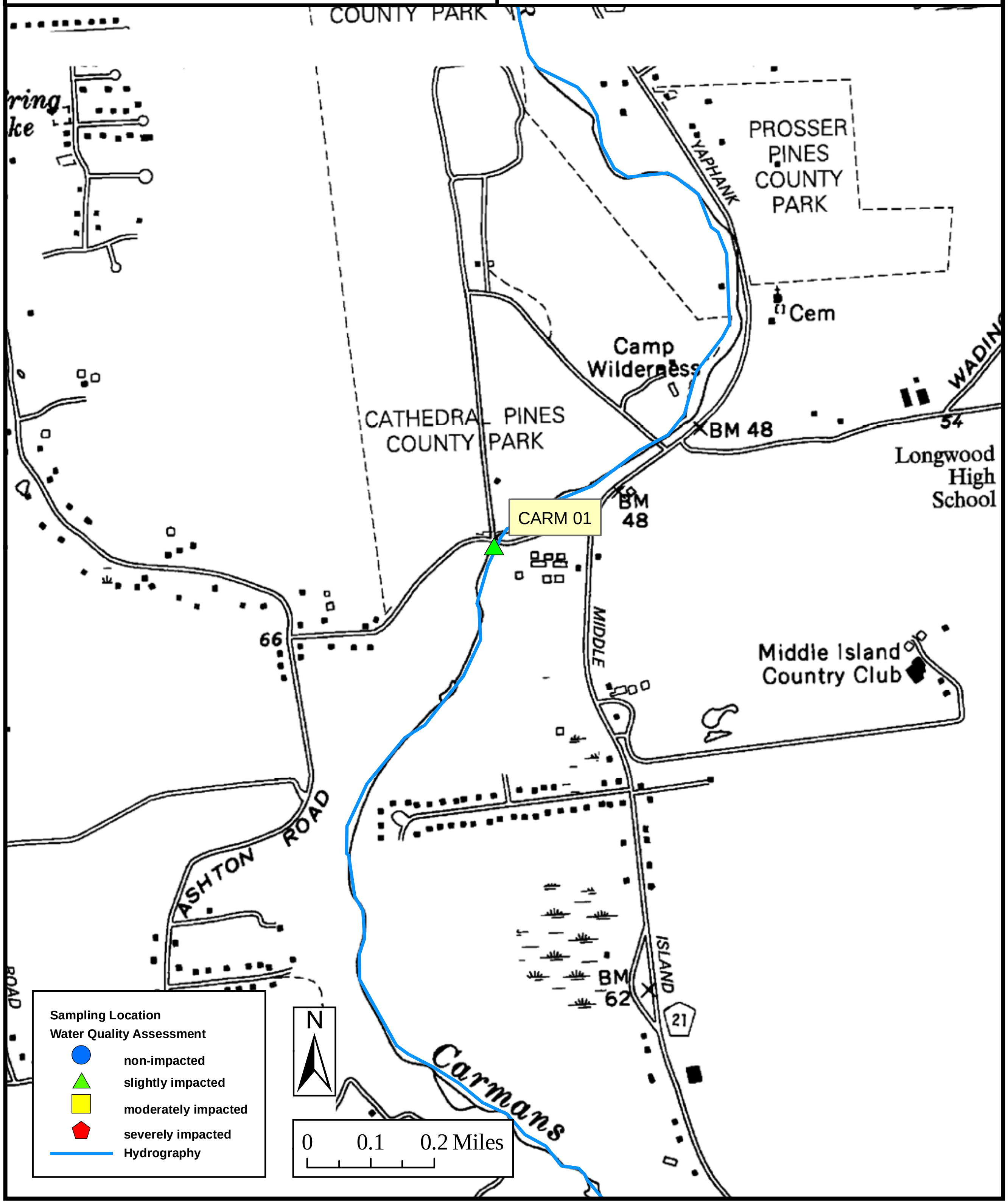


Figure 3a. Site Location Map, Carmans River, Station 02

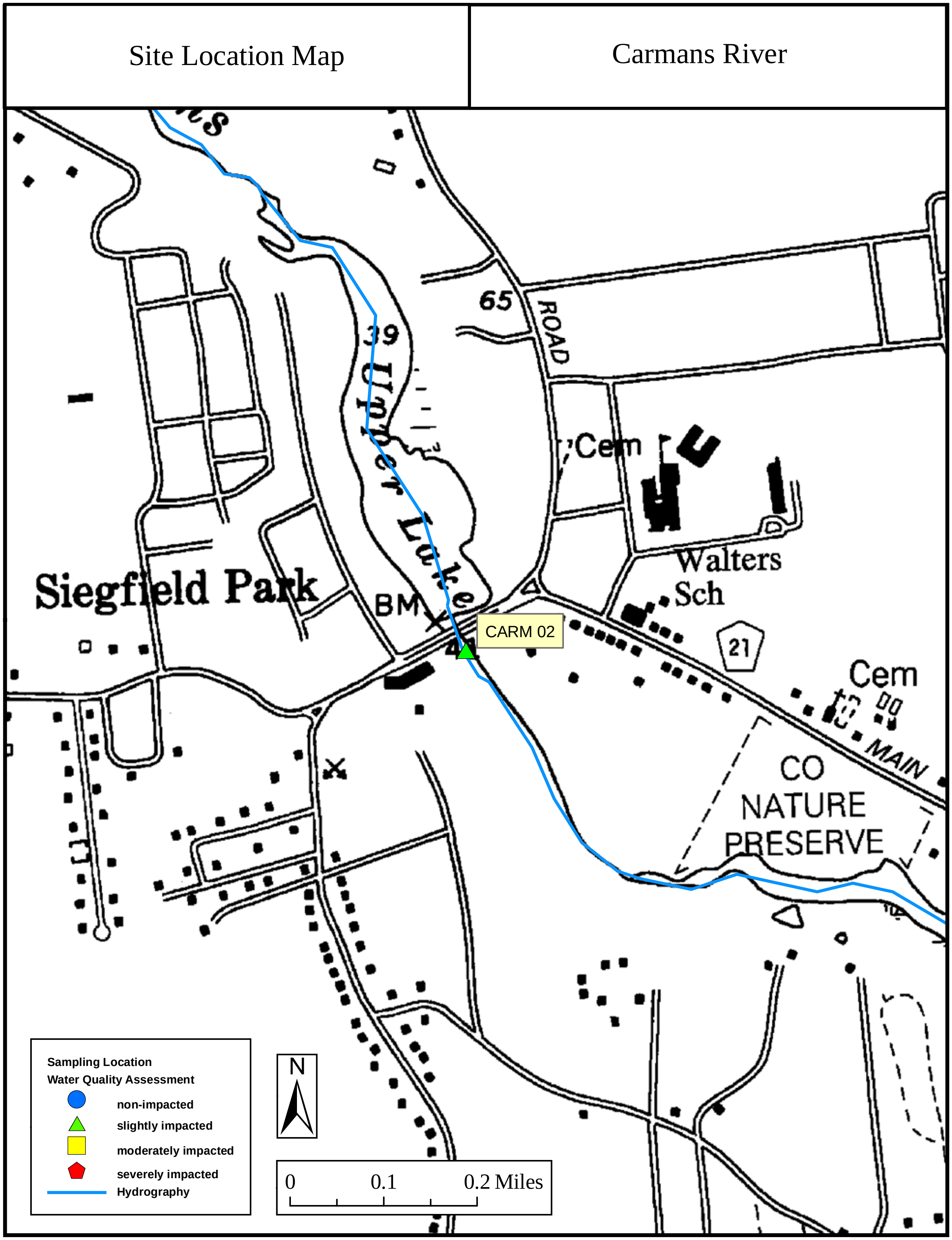


Figure 3b. Site Location Map, Carmans River, Station 03 & E.

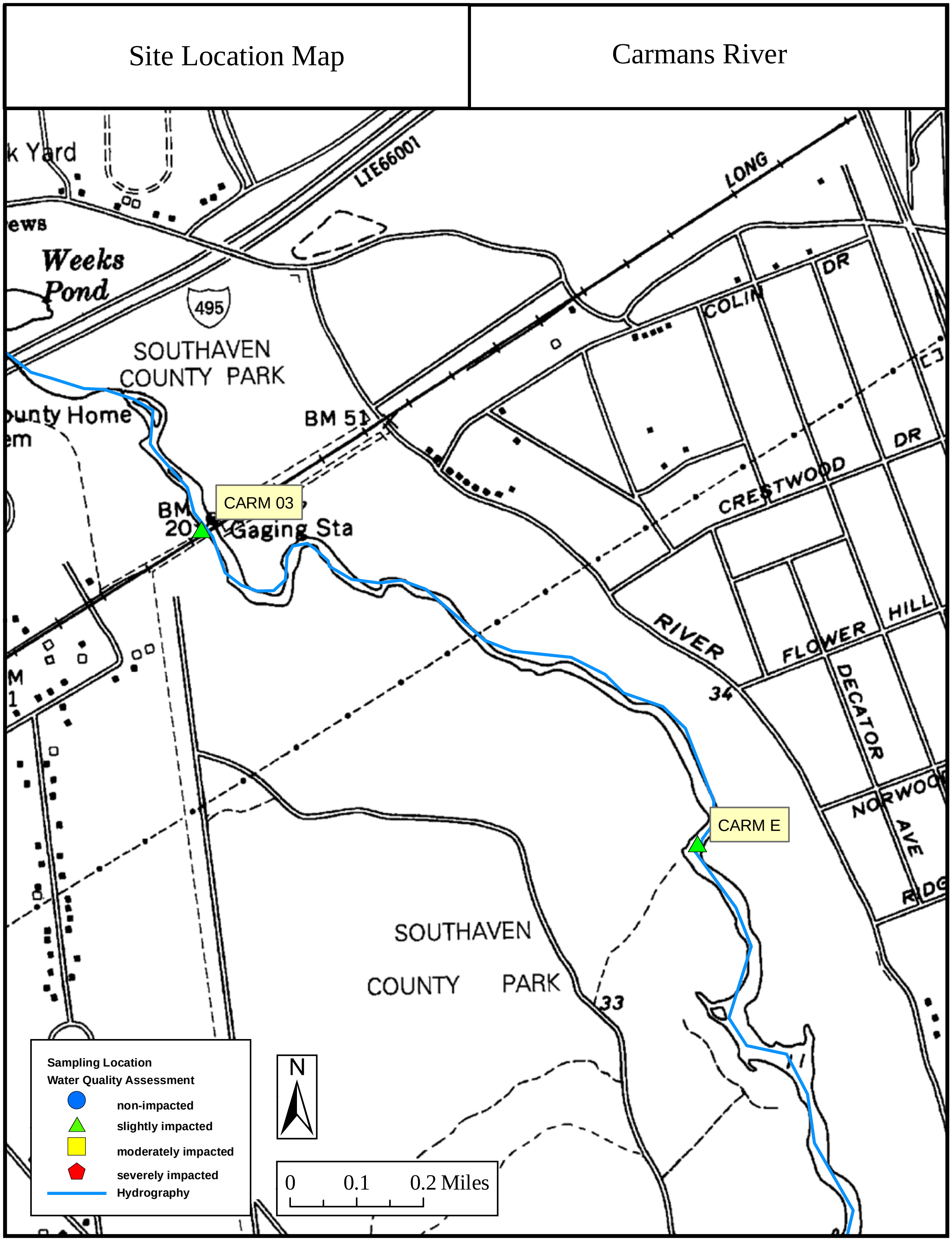


Figure 3c. Site Location Map, Carmans River, Station 04

Site Location Map	Carmans River

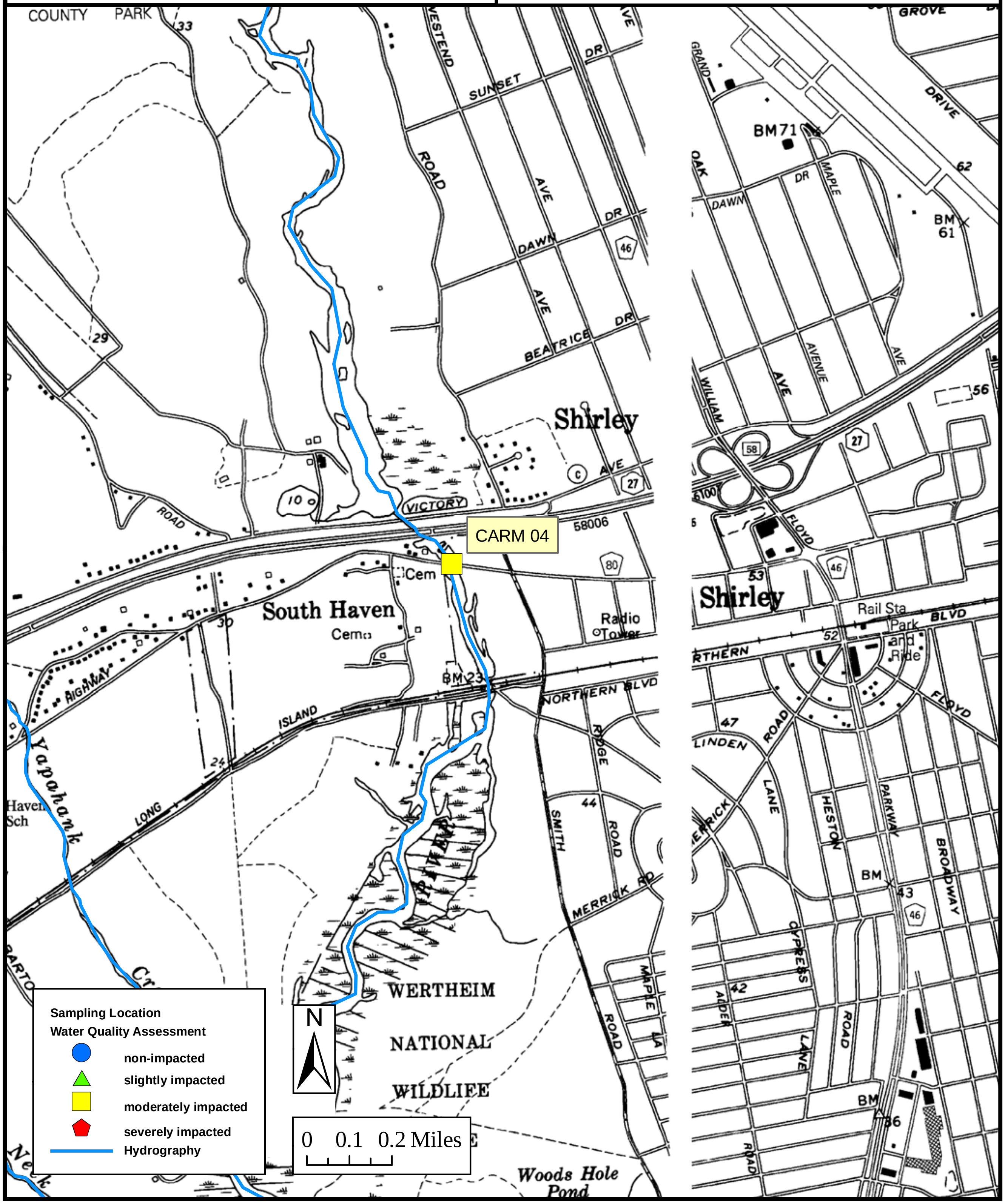


Figure 4. Nutrient Biotic Index Values for Phosphorus (NBI-P) and Nitrogen (NBI-N). NBI values are plotted on a scale of eutrophication from oligotrophic to eutrophic. See Appendix X for a detailed explanation of the index.

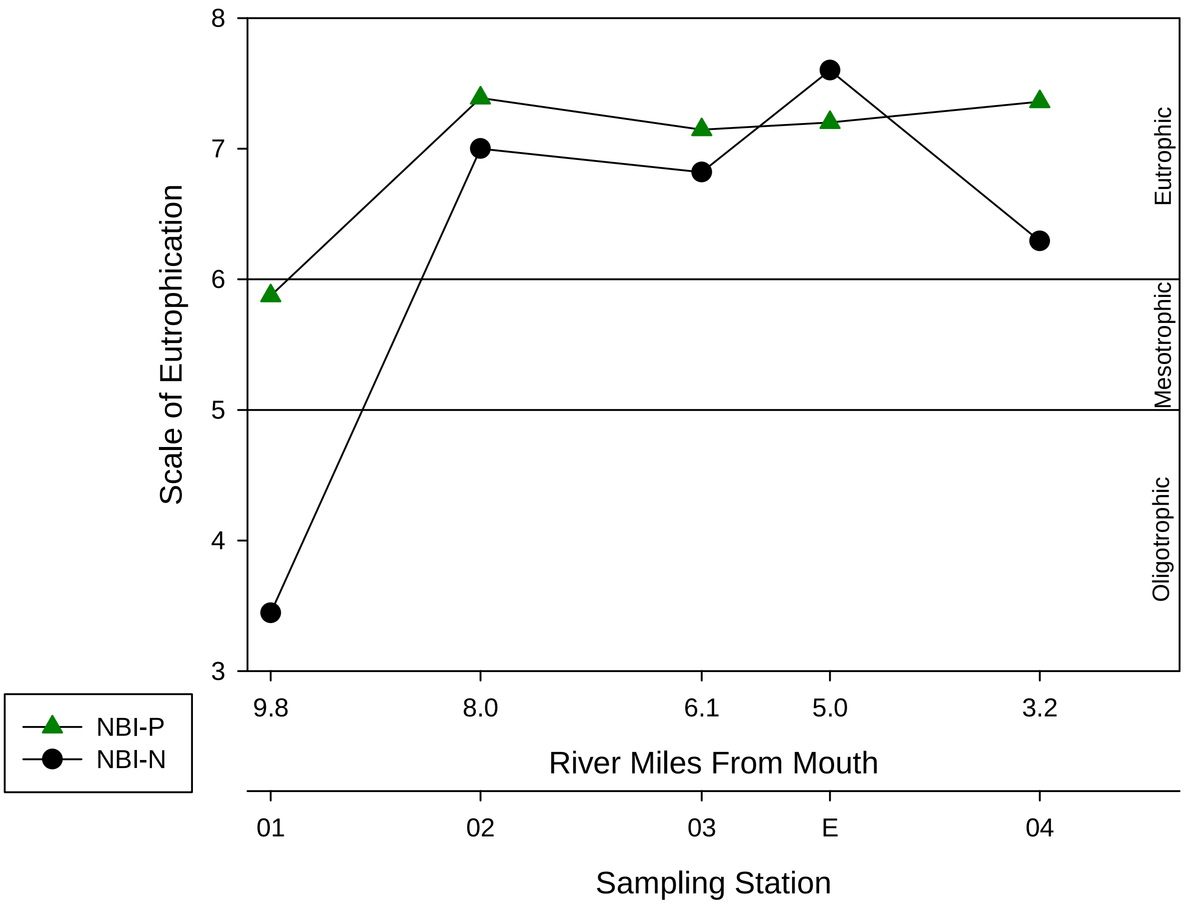


Table 4. Impact Source Determination (ISD), Carmans River, Suffolk County, 2008. Numbers represent percent similarity to community type models for each impact category. Highest similarities at each station are shaded. Similarities less than 50% are less conclusive. Highest numbers represent probable stressor(s) to the community. See Appendix XI for further explanation.

Community Type	Station				
	01	02	03	E	04
Natural: minimal human disturbance	20	23	32	14	7
Nutrient Enrichment: mostly nonpoint, agricultural	16	46	39	14	13
Toxic: industrial, municipal, or urban run-off	34	38	40	15	27
Organic: sewage effluent, animal wastes	62	40	33	14	37
Complex: municipal/industrial	33	55	46	46	57
Siltation	22	46	32	16	18
Impoundment	26	44	53	52	52

Note: Impact Source Determinations (ISDs) are intended as supplemental data to macroinvertebrate community assessments.

Table 5. Macroinvertebrate Species Collected in Carmans River, Suffolk County, 2008.

NEMERTEA
ENOPLA
HOPLONEMERTEA
Tetrastemmatidae
Undetermined Nemertea

PLATYHELMINTHES
TURBELLARIA
TRICLADIDA
Undetermined Turbellaria

ANNELIDA
OLIGOCHAETA
LUMBRICULIDA
Lumbriculidae
Undetermined Lumbriculidae

TUBIFICIDA
Enchytraeidae
Undetermined Enchytraeidae
Tubificidae
Aulodrilus pluriseta

MOLLUSCA
PELECYPODA
VENEROIDEA
Sphaeriidae
Sphaerium sp.

ARTHROPODA
CRUSTACEA
ISOPODA
Asellidae
Caecidotea communis
Caecidotea racovitzai
AMPHIPODA
Gammaridae
Gammarus sp.

INSECTA
EPHEMEROPTERA
Baetidae
Baetis intercalaris
Heterocloeon sp.
Heptageniidae
Stenonema modestum
Ephemerellidae
Serratella sp.
Undetermined Ephemerellidae

COLEOPTERA
Elmidae
Dubiraphia sp.

COLEOPTERA
Elmidae
Oulimnius latiusculus
Oulimnius sp.
Stenelmis sp.

MEGALOPTERA
Corydalidae
Nigronia serricornis
Sialidae
Sialis sp.

TRICHOPTERA
Philopotamidae
Chimarra aterrima?
Hydropsychidae
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche sparna
Odontoceridae
Psilotreta sp.
Helicopsychidae
Helicopsyche borealis
Leptoceridae
Oecetis sp.
Triaenodes sp.
Undetermined Leptoceridae

DIPTERA
Simuliidae
Simulium venustum
Simulium vittatum
Simulium sp.
Chironomidae
Larsia sp.
Cricotopus bicinctus
Cricotopus sp.
Eukiefferiella sp.
Heterotrissocladius sp.
Nanocladius sp.
Orthocladius sp.
Parachaetocladius sp.
Parakiefferiella sp.
Parametriocnemus sp.
Tvetenia bavarica gr.
Tvetenia vitracies
Undetermined Orthocladiinae
Dicrotendipes modestus
Microtendipes pedellus gr.
Polypedilum flavum
Polypedilum illinoense
Pseudochironomus sp.
Micropsectra sp.
Rheotanytarsus pellucidus

Table 6. Macroinvertebrate Data Report (MDR), Station 01

STREAM SITE: Carmans River, Station 01
LOCATION: East Bartlett Rd, Yaphank, NY
DATE: 9/10/2008
SAMPLE TYPE: Kick, Sandy Streams
SUBSAMPLE: 100 organisms

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA			
	Enchytraeidae	*Undetermined Enchytraeidae*	3
	Tubificidae	*Aulodrilus pluriseta*	1
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	*Caecidotea racovitzai*	40
AMPHIPODA	Gammaridae	*Gammarus sp.*	2
INSECTA			
COLEOPTERA	Elmidae	*Oulimnius latiusculus*	18
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	1
	Sialidae	*Sialis sp.*	1
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche sp.*	2
		Hydropsyche betteni	6
	Odontoceridae	*Psilotreta sp.*	2
	Leptoceridae	*Undetermined Leptoceridae*	1
DIPTERA	Simuliidae	*Simulium venustum*	2
	Chironomidae	*Heterotrissocladius sp.*	5
		Parachaetocladius sp.	6
		Parametriocnemus sp.	2
		Micropsectra sp.	1
		Rheotanytarsus pellucidus	7
		SPECIES RICHNESS:	17
		BIOTIC INDEX:	5.92
		EPT RICHNESS:	4
		NCO:	54
		ASSESSMENT:	slt

DESCRIPTION: Sample was taken just below culvert at East Bartlett Road. There were wetlands both above and below this section of the river. The sample was dominated by scuds, likely due to the abundance of aquatic vegetation. Water quality was assessed as slightly impacted.

Table 6a. Macroinvertebrate Data Report (MDR), Station 02

STREAM SITE:	Carmans River, Station 02
LOCATION:	Below Siegfield Park, Yaphank, NY
DATE:	9/10/2008
SAMPLE TYPE:	Kick, Sandy Streams
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	17
MOLLUSCA			
PELECYPODA			
VENEROIDEA	Sphaeriidae	*Sphaerium sp.*	7
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	*Gammarus sp.*	3
INSECTA			
EPHEMEROPTERA	Heptageniidae	*Stenonema modestum*	2
	Ephemerellidae	*Undetermined Ephemerellidae*	1
COLEOPTERA	Elmidae	*Oulimnius sp.*	10
		Stenelmis sp.	1
TRICHOPTERA	Hydropsychidae	*Cheumatopsyche sp.*	13
		Hydropsyche betteni	12
DIPTERA	Simuliidae	*Simulium venustum*	3
		Simulium vittatum	11
	Chironomidae	*Cricotopus bicinctus*	2
		Orthocladius sp.	2
		Polypedilum flavum	15
		Rheotanytarsus pellucidus	1
		SPECIES RICHNESS:	15
		BIOTIC INDEX:	5.72
		EPT RICHNESS:	4
		NCO:	53
		ASSESSMENT:	slt

DESCRIPTION: The kick sample was taken below the outlet of Upper Lake. The sample was dominated by flatworms and hydropsychid caddisflies; the latter are often found at lake outlets. There was also an abundance of aquatic vegetation. Water quality was assessed as slightly impacted.

Table 6b. Macroinvertebrate Data Report (MDR), Station 03

STREAM SITE:	Carmans River, Station 03
LOCATION:	30 m below RR bridge, Yaphank, NY
DATE:	9/10/2008
SAMPLE TYPE:	Kick, Sandy Streams
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	19
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	*Caecidotea communis*	2
AMPHIPODA	Gammaridae	*Gammarus sp.*	27
INSECTA			
EPHEMEROPTERA	Baetidae	*Heterocloeon sp.*	1
	Heptageniidae	*Stenonema modestum*	1
	Ephemerellidae	*Serratella sp.*	1
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	5
	Hydropsychidae	*Cheumatopsyche sp.*	11
	Leptoceridae	*Triaenodes sp.*	1
DIPTERA	Simuliidae	*Simulium venustum*	8
	Chironomidae	*Larsia sp.*	2
		Cricotopus bicinctus	9
		Cricotopus sp.	1
		Eukiefferiella sp.	1
		Parametriocnemus sp.	1
		Tvetenia bavarica gr.	1
		Tvetenia vitracies	5
		Polypedilum flavum	1
		Polypedilum illinoense	3
		SPECIES RICHNESS:	19
		BIOTIC INDEX:	5.66
		EPT RICHNESS:	6
		NCO:	43
		ASSESSMENT:	slt

DESCRIPTION: The sample was taken 10 meters below an old footbridge. The substrate consisted of mostly gravel and sand, with scuds dominating the kick sample. Water quality was assessed as slightly impacted, likely due to habitat restrictions.

Table 6c. Macroinvertebrate Data Report (MDR), Station E

STREAM SITE:	Carmans River, Station E
LOCATION:	E Gate, Site #5 fishing access, Yaphank, NY
DATE:	9/10/2008
SAMPLE TYPE:	Kick, Sandy Streams
SUBSAMPLE:	100 organisms

NEMERTEA			
ENOPLA			
HOPLONEMERTEA			
	Tetrastemmatidae	*Undetermined Nemertea*	8
PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA		*Undetermined Turbellaria*	14
ANNELIDA			
OLIGOCHAETA			
LUMBRICULIDA	Lumbriculidae	*Undetermined Lumbriculidae*	3
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	*Gammarus sp.*	40
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis intercalaris*	1
	Ephemerellidae	*Undetermined Ephemerellidae*	4
COLEOPTERA	Elmidae	*Oulimnius latiusculus*	12
TRICHOPTERA	Hydropsychidae	*Hydropsyche sparna*	1
	Helicopsychidae	*Helicopsyche borealis*	3
	Leptoceridae	*Undetermined Leptoceridae*	2
DIPTERA	Simuliidae	*Simulium sp.*	3
	Chironomidae	*Cricotopus sp.*	1
		Parakiefferiella sp.	3
		Tvetenia bavarica gr.	1
		Undetermined Orthocladiinae	4
		SPECIES RICHNESS:	15
		BIOTIC INDEX:	5.45
		EPT RICHNESS:	5
		NCO:	43
		ASSESSMENT:	slt

DESCRIPTION: The site is located at E Gate, in South Haven Park, Site #5, fishing access. The river here is deep and slow. The only flow is found near a man-made wooden sluiceway, where the kick sample was taken. The sample was dominated by scuds and flatworms, which are commonly associated with aquatic vegetation that was in abundance in this section of the river. This site has been frequently sampled by local Trout Unlimited members, in an effort to track any possible effects of groundwater plumes from the Yaphank LIRR Voluntary Cleanup Program Site, less than one mile north of this site, or other area spills to groundwater tables.

Table 6d. Macroinvertebrate Data Report (MDR), Station 04

STREAM SITE:	Carmans River, Station 04
LOCATION:	CR 80 @bridge, South Haven, NY
DATE:	9/10/2008
SAMPLE TYPE:	Kick, Sandy Streams
SUBSAMPLE:	100 organisms

PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
		Undetermined Turbellaria	16
ARTHROPODA			
CRUSTACEA			
ISOPODA	Asellidae	Caecidotea racovitzai	24
AMPHIPODA	Gammaridae	Gammarus sp.	40
INSECTA			
COLEOPTERA	Elmidae	Dubiraphia sp.	1
TRICHOPTERA	Hydropsychidae	Cheumatopsyche sp.	2
	Leptoceridae	Oecetis sp.	1
DIPTERA	Chironomidae	Cricotopus bicinctus	5
		Nanocladius sp.	2
		Dicrotendipes modestus	6
		Microtendipes pedellus gr.	1
		Polypedilum flavum	1
		Pseudochironomus sp.	1
		SPECIES RICHNESS:	12
		BIOTIC INDEX:	6.63
		EPT RICHNESS:	2
		NCO:	30
		ASSESSMENT:	mod

DESCRIPTION: This site is located at the DEC fishing access, north of Montauk Highway. When the sample was taken, the water was quite deep, 0.4 meter, and had a slow current, approximately 40 cm/s. These factors probably contributed to the moderately impacted assessment at this site, which was dominated by scuds , sow bugs, and flatworms.

Table 7. Laboratory Data Summary, Carmans River, Suffolk County, NY 2008.

LABORATORY DATA SUMMARY				
STREAM NAME: Carmans River				
DATE SAMPLED: 9/10/2008				
SAMPLING METHOD: Kick, Sandy Streams				
LOCATION	CARM	CARM	CARM	
STATION	01	02	03	
DOMINANT SPECIES / %CONTRIBUTION / TOLERACE / COMMON NAME				
Tolerance Definitions:	1. Caecidotea racovitzai 40 % tolerant sowbug	Undetermined Turbellaria 17 % facultative flatworm	Gammarus sp. 27 % facultative scud	
Intolerant = not tolerant of poor water quality	2. Oulimnius latiusculus 18 % intolerant beetle	Polypedilum flavum 15 % facultative midge	Undetermined Turbellaria 19 % facultative flatworm	
Facultative = occurring over a wide range of water quality	3. Rheotanytarsus pellucidus 7 % intolerant midge	Cheumatopsyche sp. 13 % facultative caddisfly	Cheumatopsych e sp. 11 % facultative caddisfly	
Tolerant = tolerant of poor water quality	4. Hydropsyche betteni 6 % facultative caddisfly	Hydropsyche betteni 12 % facultative caddisfly	Cricotopus bicinctus 9 % tolerant midge	
	5. Parachaetocladiu s sp. 6 % intolerant midge	Simulium vittatum 11 % facultative black fly	Simulium venustum 8 % facultative black fly	
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESIS)				
Chironomidae (midges)	21 (5.0)	20 (4.0)	24 (9.0)	
Trichoptera (caddisflies)	11 (4.0)	25 (2.0)	17 (3.0)	
Ephemeroptera (mayflies)	0 (0.0)	3 (2.0)	3 (3.0)	
Plecoptera (stoneflies)	0 (0.0)	0 (0.0)	0 (0.0)	
Coleoptera (beetles)	18 (1.0)	11 (2.0)	0 (0.0)	
Oligochaeta (worms)	4 (2.0)	0 (0.0)	0 (0.0)	
Mollusca (clams and snails)	0 (0.0)	7 (1.0)	0 (0.0)	
Crustacea (crayfish, scuds, sowbugs)	42 (2.0)	3 (1.0)	29 (2.0)	
Other insects (odonates, diptera)	4 (3.0)	14 (2.0)	8 (1.0)	
Other (Nemertea, Platyhelminthes)	0 (0.0)	1 (0.0)	1 (0.0)	
SPECIES RICHNESS	17	15	19	
BIOTIC INDEX	5.92	5.72	5.66	
EPT RICHNESS	4	4	6	
PERCENT MODEL AFFINITY	54	53	43	
FIELD ASSESSMENT	Good	Poor	Very Good	
OVERALL ASSESSMENT	slightly impacted	slightly impacted	slightly impacted	

Table 7a. Laboratory Data Summary, Carmans River, Suffolk County, NY 2008.

LABORATORY DATA SUMMARY				
STREAM NAME: Carmans River				
DATE SAMPLED: 9/10/2008				
SAMPLING METHOD: Kick, Sandy Streams				
LOCATION	CARM	CARM		
STATION	04	E		
DOMINANT SPECIES / %CONTRIBUTION / TOLERACE / COMMON NAME				
Tolerance Definitions:	1. Gammarus sp. 40 % facultative scud	Gammarus sp. 40 % facultative scud		
Intolerant = not tolerant of poor water quality	2. Caecidotea racovitzai 24 % tolerant sowbug	Undetermined Turbellaria 14 % facultative flatworm		
Facultative = occurring over a wide range of water quality	3. Undetermined Turbellaria 16 % facultative flatworm	Oulimnius latiusculus 12 % intolerant beetle		
Tolerant = tolerant of poor water quality	4. Dicrotendipes modestus 6 % tolerant midge	Undetermined Nemertea 8 % tolerant nemertean		
	5. Cricotopus bicinctus 5 % tolerant midge	Undetermined Ephemerellidae 4 % intolerant mayfly		
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESIS)				
Chironomidae (midges)	16 (6.0)	9 (4.0)		
Trichoptera (caddisflies)	3 (2.0)	6 (3.0)		
Ephemeroptera (mayflies)	0 (0.0)	5 (2.0)		
Plecoptera (stoneflies)	0 (0.0)	0 (0.0)		
Coleoptera (beetles)	1 (1.0)	12 (1.0)		
Oligochaeta (worms)	0 (0.0)	3 (1.0)		
Mollusca (clams and snails)	0 (0.0)	0 (0.0)		
Crustacea (crayfish, scuds, sowbugs)	64 (2.0)	40 (1.0)		
Other insects (odonates, diptera)	0 (0.0)	3 (1.0)		
Other (Nemertea, Platyhelminthes)	1 (0.0)	2 (0.0)		
SPECIES RICHNESS	12	15		
BIOTIC INDEX	6.63	5.45		
EPT RICHNESS	2	5		
PERCENT MODEL AFFINITY	30	43		
FIELD ASSESSMENT	Good	Poor		
OVERALL ASSESSMENT	moderately impacted	slightly impacted		

Table 8. Field Data Summary, Carmans River, Suffolk County, NY 2008.

FIELD DATA SUMMARY				
STREAM NAME: Carmans River	DATE SAMPLED: 9/10/2008			
REACH:				
FIELD PERSONNEL INVOLVED: Heitzman/Donlon				
STATION	01	02	03	
ARRIVAL TIME AT STATION	11:15	12:00	1:20	
LOCATION	CARM	CARM	CARM	
PHYSICAL CHARACTERISTICS				
Width (meters)	2	8	15	
Depth (meters)	<0.1	0.2	0.2	
Current speed (cm per sec.)	50	71	100	
Substrate (%)				
Rock (>25.4 cm, or bedrock)	5			
Rubble (6.35 - 25.4 cm)	5	10	20	
Gravel (0.2 - 6.35 cm)	10	40	40	
Sand (0.06 - 2.0 mm)	60	40	30	
Silt (0.004 - 0.06 mm)	20	10	10	
Embeddedness (%)	40	30	30	
CHEMICAL MEASUREMENTS				
Temperature (Celsius)	17.8	20.9	19.5	
Specific Conductance (umhos)	161	157.4	170.5	
Dissolved Oxygen (mg/l)	7.7	8.53	9.87	
pH	7.4	7.4	7.3	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	90	50	10	
Aquatic Vegetation				
Algae - suspended			X	
Algae - attached,filamentous	X	X	X	
Algae - diatoms	20	10	40	
Macrophytes or moss	20	30	75	
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	
Plecoptera (stoneflies)			X	
Trichoptera (caddisflies)	X	X	X	
Coleoptera (beetles)	X		X	
Megaloptera (dobsonflies, damselflies)	X			
Odonata (dragonflies, damselflies)	X			
Chironomidae (midges)				
Simuliidae (black flies)	X	X		
Decapoda (crayfish)				
Gammaridae (scuds)			X	
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other			X	
FAUNAL CONDITION	Good	Poor	Very Good	

Table 8a. Field Data Summary, Carmans River, Suffolk County, NY 2008.

FIELD DATA SUMMARY				
STREAM NAME: Carmans River	**DATE SAMPLED:** 9/10/2008			
REACH:				
FIELD PERSONNEL INVOLVED: Heitzman/Donlon				
STATION	04	E		
ARRIVAL TIME AT STATION	2:15	3:15		
LOCATION	CARM	CARM		
PHYSICAL CHARACTERISTICS				
Width (meters)	20	25		
Depth (meters)	0.4	0.4		
Current speed (cm per sec.)	59	42		
Substrate (%)				
Rock (>25.4 cm, or bedrock)		10		
Rubble (6.35 - 25.4 cm)		5		
Gravel (0.2 - 6.35 cm)	40	30		
Sand (0.06 - 2.0 mm)	40	35		
Silt (0.004 - 0.06 mm)	20	20		
Embeddedness (%)	20	50		
CHEMICAL MEASUREMENTS				
Temperature (Celsius)	19.5	19.7		
Specific Conductance (umhos)	192.6	189.1		
Dissolved Oxygen (mg/l)	13.3	9.56		
pH	7.6	7.4		
BIOLOGICAL ATTRIBUTES				
Canopy (%)	10	25		
Aquatic Vegetation				
Algae - suspended	X	X		
Algae - attached,filamentous	X	X		
Algae - diatoms		40		
Macrophytes or moss	X	X		
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X		
Plecoptera (stoneflies)				
Trichoptera (caddisflies)	X	X		
Coleoptera (beetles)	X			
Megaloptera (dobsonflies, damselflies)				
Odonata (dragonflies, damselflies)		X		
Chironomidae (midges)		X		
Simuliidae (black flies)				
Decapoda (crayfish)				
Gammaridae (scuds)	X	X		
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other	X			
FAUNAL CONDITION	Good	Poor		

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 three 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 meter 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) The site should have 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 organisms are dislodged and carried into the net. Sampling is continued for a specified time and distance in the stream. Rapid assessment sampling specifies sampling for five minutes over a distance of five meters. The contents of the net are emptied into a pan of stream water, examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

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

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

Appendix II. Macroinvertebrate Community Parameters

1. Species Richness: the total number of species or taxa found in a sample. For subsamples of 100-organisms each that are taken from kick samples, expected ranges in most New York State streams are: greater than 26, non-impacted; 19-26, slightly impacted; 11-18, moderately impacted, and less than 11, severely impacted.

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

3. Hilsenhoff Biotic Index: a measure of the tolerance of organisms in a 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 the purpose of characterizing species' tolerance, intolerant = 0-4, facultative = 5-7, and tolerant = 8-10. Tolerance 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 Quality Assurance document, Bode et al. (2002). Impact ranges 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: a measure of similarity to a model, non-impacted community based on percent abundance in seven major macroinvertebrate groups (Novak and Bode, 1992). Percentage abundances in the model community are: 40% Ephemeroptera; 5% Plecoptera; 10% Trichoptera; 10% Coleoptera; 20% Chironomidae; 5% Oligochaeta; and 10% Other. Impact ranges are: greater than 64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted, and less than 35, severely impacted.

5. Nutrient Biotic Index: a measure of stream nutrient enrichment identified by macroinvertebrate taxa. 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 with assigned tolerance values. Tolerance values ranging from intolerant (0) to tolerant (10) are based on nutrient optima for Total Phosphorus (listed in Smith, 2005). Impact ranges are: 0-5.00, non-impacted; 5.01-6.00, slightly impacted; 6.01-7.00, moderately impacted, and 7.01-10.00, severely impacted.

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 richness, biotic index, and percent model affinity (see Appendix II). The consensus is based on the determination of the majority of the parameters. Since parameters measure different aspects of the macroinvertebrate community, they cannot be expected to always form unanimous assessments. The assessment ranges given for each parameter are based on subsamples of 100-organisms each that are taken from macroinvertebrate riffle kick samples. These assessments also apply to most multiplate samples, with the exception of percent model affinity.

1. *Non-impacted*: Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 27 species in riffle habitats. Mayflies, stoneflies, and caddisflies are well represented; EPT richness is greater than 10. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Nutrient Biotic Index is 5.00 or less. 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.

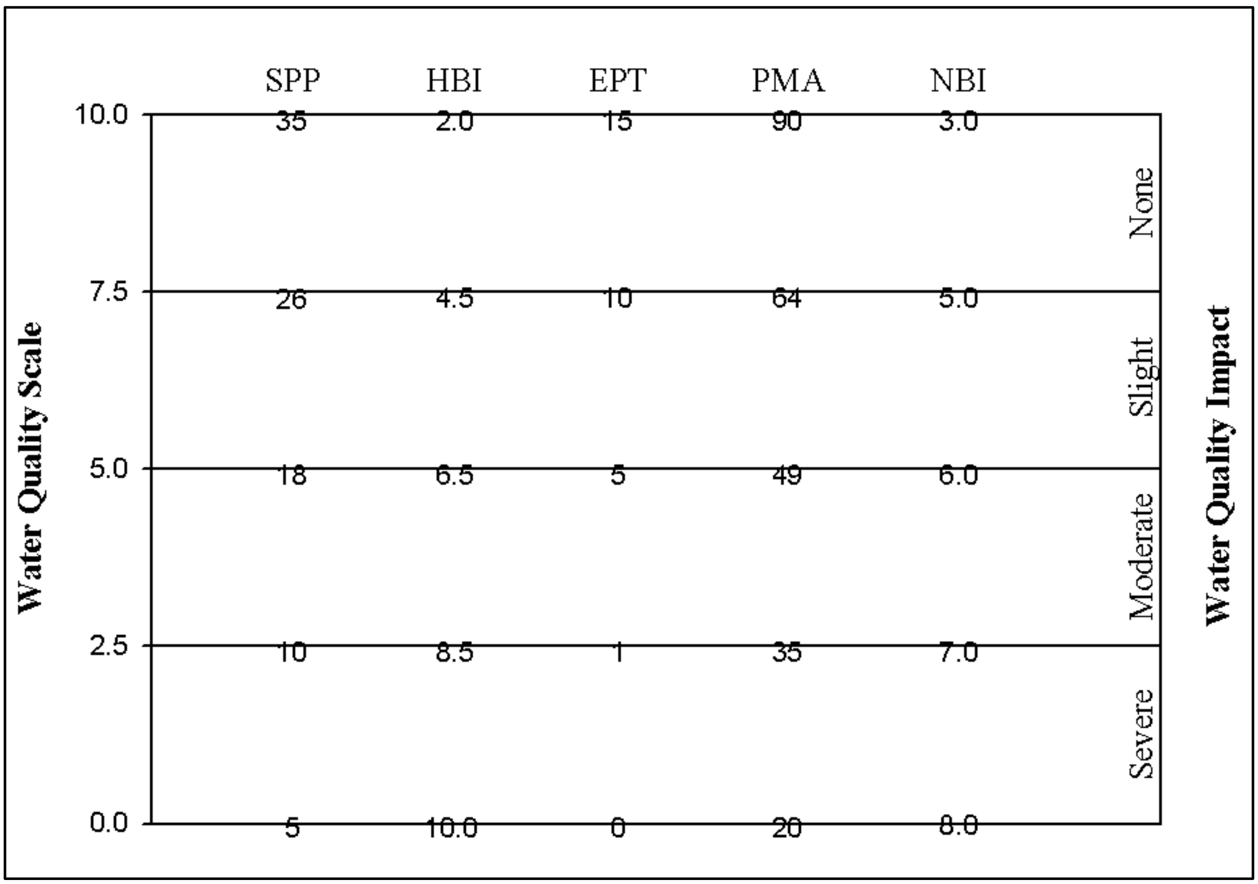
2. *Slightly impacted*: Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness is usually 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Nutrient Biotic Index is 5.01-6.00. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

3. *Moderately impacted*: Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Species richness is usually 11-18 species. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; the EPT richness is 2-5. The biotic index value is 6.51-8.50. Percent model affinity is 35-49. Nutrient Biotic Index is 6.01-7.00. Water quality often is limiting to fish propagation, but usually not to fish survival.

4. *Severely impacted*: Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant species. Species richness is 10 or fewer. Mayflies, stoneflies and caddisflies are rare or absent; EPT richness is 0-1. The biotic index value is greater than 8.50. Percent model affinity is less than 35. Nutrient Biotic Index is greater than 7.00. 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-A. Biological Assessment Profile: Conversion of Index Values to a 10-Scale

The Biological Assessment Profile (BAP) of index values, developed by Phil O'Brien, Division of Water, NYSDEC, is a method of plotting biological index values on a common scale of water quality impact. Values from the five indices—species richness (SPP), EPT richness (EPT), Hilsenhoff Biotic Index (HBI), Percent Model Affinity (PMA), and Nutrient Biotic Index (NBI)—defined in Appendix II are converted to a common 0-10 scale using the formulae in the Quality Assurance document (Bode, et al., 2002), and as shown in the figure below.



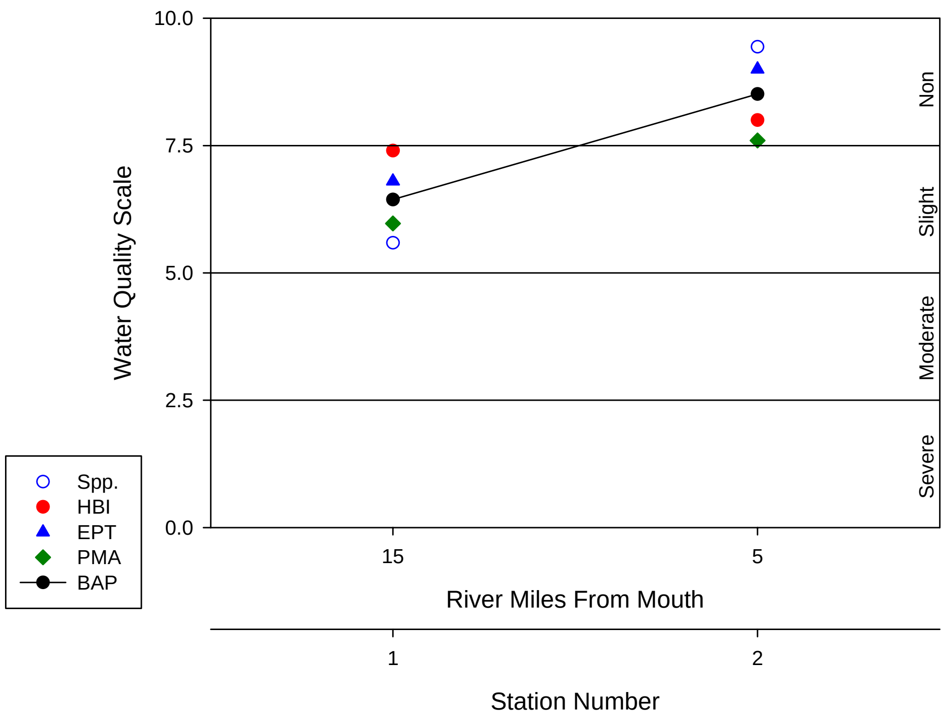
Appendix IV-B. Biological Assessment Profile: Plotting Values

To plot survey data:
1. Position each site on the x-axis according to miles or tenths of a mile upstream of the mouth.
2. Plot the values of the four indices for each site as indicated by the common scale.
3. Calculate the mean of the four values and plot the result. This represents the assessed impact for each site.

Example data:

	Station 1		Station 2	
	metric value	10-scale value	metric value	10-scale value
Species richness	20	5.59	33	9.44
Hilsenhoff Biotic Index	5.00	7.40	4.00	8.00
EPT richness	9	6.80	13	9.00
Percent Model Affinity	55	5.97	65	7.60
Average		6.44 (slight)		8.51 (non-)

Sample BAP plot:



Appendix V. Water Quality Assessment Criteria

Non-Navigable Flowing Waters

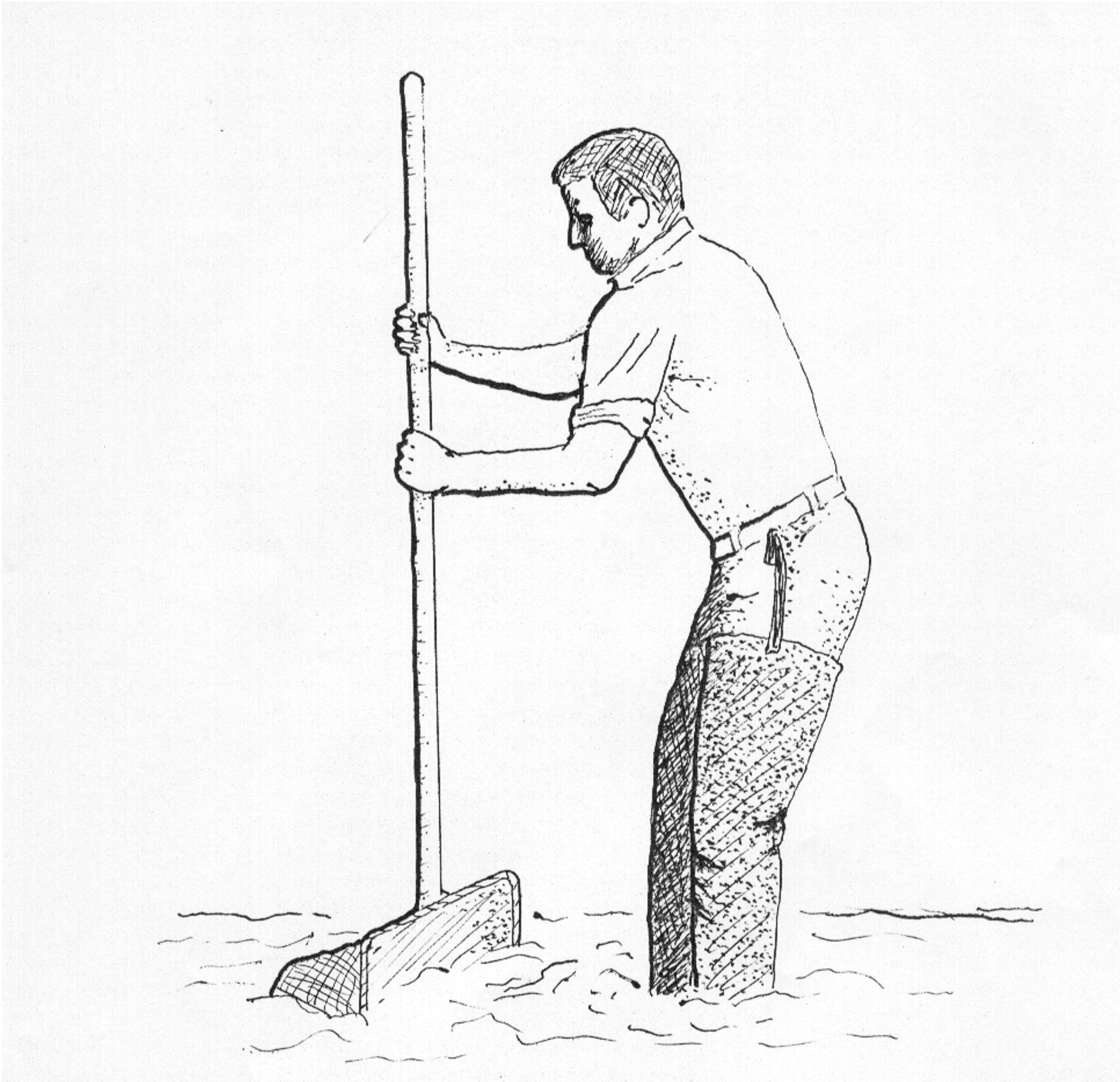
	Species Richness	Hilsenhoff Biotic Index	EPT Value	Percent Model Affinity*	Diversity **
Non-Impacted	>26	0.00-4.50	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	0-1	<35	0.00-2.00

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

Navigable Flowing Waters

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

Appendix VI. The Traveling Kick Sample



⟵current

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

Appendix VII-A. Aquatic Macroinvertebrates Usually Indicative of Good Water Quality

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

MAYFLIES

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

STONEFLIES

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

CADDISFLIES

The most common beetles in streams are riffle beetles (adult and larva pictured) and water pennies (not shown). Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.

Appendix VII-B. Aquatic Macroinvertebrates Usually Indicative of Poor Water Quality

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

MIDGES

Black fly larvae have specialized structures for filtering plankton and bacteria from the water, and require a strong current. Some species are tolerant of organic enrichment and toxic contaminants, while others are intolerant of pollutants.

BLACK FLIES

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

WORMS

Aquatic sowbugs are crustaceans that are often numerous in situations of high organic content and low oxygen levels. They are classic indicators of sewage pollution, and can also thrive in toxic situations.

SOWBUGS

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

Appendix VIII. The Rationale of Biological Monitoring

Biological monitoring 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 that they:

- are sensitive to environmental impacts
- are less mobile than fish, and thus cannot avoid discharges
- can indicate effects of spills, intermittent discharges, and lapses in treatment
- are indicators of overall, integrated water quality, including synergistic effects
- are abundant in most streams and are relatively easy and inexpensive to sample
- are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
- are vital components of the aquatic ecosystem and important as a food source for fish
- are more readily perceived by the public as tangible indicators of water quality
- can often provide an on-site estimate of water quality
- can often be used to identify specific stresses or sources of impairment
- can be preserved and archived for decades, allowing for direct comparison of specimens
- 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

Anthropogenic: caused by human actions

Assessment: a diagnosis or evaluation of water quality

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

Bioaccumulate: accumulate contaminants in the tissues of an organism

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

Electrofishing: sampling fish by using electric currents to temporarily immobilize them, allowing capture

EPT richness: the number of taxa of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) in a sample or subsample

Eutrophic: high nutrient levels normally leading to excessive biological productivity

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

Longitudinal trends: upstream-downstream changes in water quality in a river or stream

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

Mesotrophic: intermediate nutrient levels (between oligotrophic and eutrophic) normally leading to moderate biological productivity

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

Non Chironomidae/Oligochaeta (NCO) richness: the number of taxa neither belonging to the family Chironomidae nor the subclass Oligochaeta in a sample or subsample

Oligotrophic: low nutrient levels normally leading to unproductive biological conditions

Organism: a living individual

PAHs: Polycyclic Aromatic Hydrocarbons, a class of organic compounds that are often toxic or carcinogenic

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 taxa 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

Synergistic effect: an effect produced by the combination of two factors that is greater than the sum of the two factors

Tolerant: able to survive poor water quality

Trophic: referring to productivity

Appendix X. Methods for Calculation of the Nutrient Biotic Index

Definition: The Nutrient Biotic Index (Smith et al., 2007) is a diagnostic measure of stream nutrient enrichment identified by macroinvertebrate taxa. The frequency of occurrences of taxa at varying nutrient concentrations allows the identification of taxon-specific nutrient optima using a method of weighted averaging. The establishment of nutrient optima is possible based on the observation that most species exhibit unimodal response curves in relation to environmental variables (Jongman et al., 1987). The assignment of tolerance values to taxa based on their nutrient optimum provids the ability to reduce macroinvertebrate community data to a linear scale of eutrophication from oligotrophic to eutrophic. Two tolerance values were assigned to each taxon, one for total phosphorus, and one for nitrate (listed in Smith, 2005). This provides the ability to calculate two different nutrient biotic indices, one for total phosphorus (NBI-P), and one for nitrate (NBI-N). Study of the indices indicates better performance by the NBI-P, with strong correlations to stream nutrient status assessment based on diatom information.

Calculation of the NBI-P and NBI-N: Calculation of these two indices follows the approach of Hilsenhoff (1987)...

$$\text{NBI Score}_{(\text{TP or NO3}^-)} = \sum (a \times b) / c$$

where ***a*** is equal to the number of individuals for each taxon, ***b*** is the taxon's tolerance value, and ***c*** is the total number of individuals in the sample for which tolerance values have been assigned.

Classification of NBI Scores: NBI scores have been placed on a scale of eutrophication with provisional boundaries between stream trophic statuses.

Index	Oligotrophic	Mesotrophic	Eutrophic
NBI-P	< 5.0	> 5.0 - 6.0	> 6.0
NBI-N	< 4.5	> 4.5 - 6.0	> 6.0

Jongman, R. H. G., C. J. F. ter Braak and O. F. R. van Tongeren. 1987. Data Analysis in Community and Landscape Ecology. Pudoc Wageningen, Netherlands, 299 pages.

Smith, A.J., R. W. Bode, and G. S. Kleppel. 2007. A Nutrient Biotic Index for Use with Benthic Macroinvertebrate Communities. Ecological Indicators 7(200):371-386.

Tolerance Values Assigned to Taxa for Calculation of Nutrient Biotic Indices

TAXON	TP T-Value	NO3 T-Value
Acentrella sp.	5	5
Acerpenna pygmaea	0	4
Acroneuria abnormis	0	0
Acroneuria sp.	0	0
Agnetina capitata	3	6
Anthopotamus sp.	4	5
Antocha sp.	8	6
Apatania sp.	3	4
Atherix sp.	8	5
Baetis brunneicolor	1	5
Baetis flavistriga	7	7
Baetis intercalaris	6	5
Baetis sp.	6	3
Baetis tricaudatus	8	9
Brachycentrus appalachia	3	4
Caecidotea racovitzai	6	2
Caecidotea sp.	7	9
Caenis sp.	3	3
Cardiocladius obscurus	8	6
Cheumatopsyche sp.	6	6
Chimarra aterrima?	2	3
Chimarra obscura	6	4
Chimarra socia	4	1
Chimarra sp.	2	0
Chironomus sp.	9	6
Cladotanytarsus sp.	6	4
Corydalus cornutus	2	2
Cricotopus bicinctus	7	6
Cricotopus tremulus gr.	8	9
Cricotopus trifascia gr.	9	9
Cricotopus vierriensis	6	5
Cryptochironomus fulvus gr.	5	6
Diamesa sp.	10	10
Dicranota sp.	5	10
Dicrotendipes neomodestus	10	4
Dolophilodes sp.	4	3
Drunella cornutella	4	4
Ectopria nervosa	10	9
Epeorus (Iron) sp.	0	0
Ephemerella sp.	4	4
Ephemerella subvaria	4	1
Ephoron leukon?	1	1
Eukiefferiella devonica gr.	9	9
Ferrissia sp.	9	5
Gammarus sp.	8	9
Glossosoma sp.	6	0
Goniobasis livescens	10	10
Helicopsyche borealis	1	2
Hemerodromia sp.	5	6
Heptagenia sp.	0	0
Hexatoma sp.	0	1
Hydropsyche betteni	7	9
Hydropsyche bronta	7	6
Hydropsyche morosa	5	1
Hydropsyche scalaris	3	3
Hydropsyche slossonae	6	10
Hydropsyche sp.	5	4
Hydropsyche sparna	6	7
Hydroptila consimilis	9	10
Hydroptila sp.	6	6
Hydroptila spatulata	9	8
Isonychia bicolor	5	2
Lepidostoma sp.	2	0
Leucotrichia sp.	6	2
Leucrocuta sp.	1	3
Macrostemum carolina	7	2
Macrostemum sp.	4	2
Micrasema sp. 1	1	0
Micropsectra dives gr.	6	9
Micropsectra polita	0	7
Micropsectra sp.	3	1
Microtendipes pedellus gr.	7	7
Microtendipes rydalensis gr.	2	1
Nais variabilis	5	0
Neoperla sp.	5	5
Neureclipsis sp.	3	1
Nigronia serricornis	10	8
Nixe (Nixe) sp.	1	5
Ophiogomphus sp.	1	3
Optioservus fastiditus	6	7
Optioservus ovalis	9	4
Optioservus sp.	7	8
Optioservus trivittatus	7	6
Orthocladius nr. dentifer	3	7
Pagastia orthogonia	4	8
Paragnetina immarginata	1	2
Paragnetina media	6	3
Paragnetina sp.	1	6
Paraleptophlebia mollis	2	1
Paraleptophlebia sp.	2	3
Parametriocnemus lundbecki	8	10
Paratanytarsus confusus	5	8
Pentaneura sp.	0	1
Petrophila sp.	5	3
Phaenopsectra dyari?	4	5
Physella sp.	8	7
Pisidium sp.	8	10
Plauditus sp.	2	6
Polycentropus sp.	4	2
Polypedilum aviceps	5	7
Polypedilum flavum	9	7
Polypedilum illinoense	10	7
Polypedilum laetum	7	6
Polypedilum scalaenum gr.	10	6
Potthastia gaedii gr.	9	10
Promoresia elegans	10	10
Prostoma graecense	2	7
Psephenus herricki	10	9
Psephenus sp.	3	4

NBI tolerance values (cont'd.)

TAXON	TP T-Value	NO3 T-Value
Psychomyia flavida	1	0
Rheocricotopus robacki	4	4
Rheotanytarsus exiguus gr.	6	5
Rheotanytarsus pellucidus	3	2
Rhithrogena sp.	0	1
Rhyacophila fuscula	2	5
Rhyacophila sp.	0	1
Serratella deficiens	5	2
Serratella serrata	1	0
Serratella serratoides	0	1
Serratella sp.	1	1
Sialis sp.	5	6
Simulium jenningsi	6	2
Simulium sp.	7	6
Simulium tuberosum	1	0
Simulium vittatum	7	10
Sphaerium sp.	9	4
Stenacron interpunctatum	7	7
Stenelmis concinna	5	0
Stenelmis crenata	7	7
Stenelmis sp.	7	7
Stenochironomus sp.	4	3
Stenonema mediopunctatum	3	3
Stenonema modestum	2	5
Stenonema sp.	5	5
Stenonema terminatum	2	3
Stenonema vicarium	6	7
Stylaria lacustris	5	2
Sublettea coffmani	3	5

TAXON	TP T-Value	NO3 T-Value
Synorthocladius nr. semivirens	6	9
Tanytarsus glabrescens gr.	5	6
Tanytarsus guerlus gr.	5	5
Thienemannimyia gr. spp.	8	8
Tipula sp.	10	10
Tricorythodes sp.	4	9
Tvetenia bavarica gr.	9	10
Tvetenia vitracies	7	6
Undet. Tubificidae w/ cap. setae	10	8
Undet. Tubificidae w/o cap. setae	7	7
Undetermined Cambaridae	6	5
Undet. Ceratopogonidae	8	9
Undet. Enchytraeidae	7	8
Undet. Ephemerellidae	3	6
Undetermined Gomphidae	2	0
Undet. Heptageniidae	5	2
Undetermined Hirudinea	9	10
Undetermined Hydrobiidae	6	7
Undetermined Hydroptilidae	5	2
Undet. Limnephilidae	3	4
Undet. Lumbricina	8	8
Undet. Lumbriculidae	5	6
Undetermined Perlidae	5	7
Undetermined Sphaeriidae	10	8
Undetermined Turbellaria	8	6
Zavrelia sp.	9	9

Appendix XI. Impact Source Determination Methods and Community Models

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. ISD uses community types or models to ascertain the primary factor influencing the fauna.

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

Use of the ISD methods: Impact Source Determination is based on similarity to existing models of community types (see tables following). The model that exhibits the highest similarity to the test data denotes the likely impact source type, or may indicate "natural," lacking an impact. In the graphic representation of ISD, only the highest similarity of each source type is identified. If no model exhibits a similarity to the test data of greater than 50 percent, 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 subsamples of 100-organisms each that are taken from traveling kick samples of New York State streams. Application of these methods for data derived from other sampling methods, habitats or geographical areas would likely require modification of the models.

ISD Models

	NATURAL												
	A	B	C	D	E	F	G	H	I	J	K	L	M
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	-	-	5	-	5	-	5	5	-	-	-	5	5
HIRUDINEA	-	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
GAMMARIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
Isonychia	5	5	-	5	20	-	-	-	-	-	-	-	-
BAETIDAE	20	10	10	10	10	5	10	10	10	10	5	15	40
HEPTAGENIIDAE	5	10	5	20	10	5	5	5	5	10	10	5	5
LEPTOPHLEBIIDAE	5	5	-	-	-	-	-	-	5	-	-	25	5
EPHEMERELLIDAE	5	5	5	10	-	10	10	30	-	5	-	10	5
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	5	5	-	5	5	15	5	5	5	5
Psephenus	5	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	5	-	20	5	5	-	5	5	5	5	-	-	-
Promoresia	5	-	-	-	-	-	25	-	-	-	-	-	-
Stenelmis	10	5	10	10	5	-	-	-	10	-	-	-	5
PHILOPOTAMIDAE	5	20	5	5	5	5	5	-	5	5	5	5	5
HYDROPSYCHIDAE	10	5	15	15	10	10	5	5	10	15	5	5	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	5	5	-	-	-	20	-	5	5	5	5	5	-
SIMULIIDAE	-	-	-	5	5	-	-	-	-	5	-	-	-
Simulium vittatum	-	-	-	-	-	-	-	-	-	-	-	-	-
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-
TIPULIDAE	-	-	-	-	-	-	-	-	5	-	-	-	-
CHIRONOMIDAE													
Tanypodinae	-	5	-	-	-	-	-	-	5	-	-	-	-
Diamesinae	-	-	-	-	-	-	5	-	-	-	-	-	-
Cardiocladius	-	5	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	5	-	-	10	-	-	5	-	-	5	5	5
Eukiefferiella/ Tvetenia	5	5	10	-	-	5	5	5	-	5	-	5	5
Parametriocnemus	-	-	-	-	-	-	-	5	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	20	-	-	10	20	20	5	-
Polypedilum (all others)	5	5	5	5	5	-	5	5	-	-	-	-	-
Tanytarsini	-	5	10	5	5	20	10	10	10	10	40	5	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

ISD Models (cont'd.)

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

ISD Models (cont'd.)

	MUNICIPAL/INDUSTRIAL								TOXIC					
	A	B	C	D	E	F	G	H	A	B	C	D	E	F
PLATYHELMINTHES	-	40	-	-	-	5	-	-	-	-	-	-	5	-
OLIGOCHAETA	20	20	70	10	-	20	-	-	-	10	20	5	5	15
HIRUDINEA	-	5	-	-	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	5	-	-	-	5	-	-	-	5
SPHAERIIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
ASELLIDAE	10	5	10	10	15	5	-	-	10	10	-	20	10	5
GAMMARIDAE	40	-	-	-	15	-	5	5	5	-	-	-	5	5
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	5	-	-	-	5	-	10	10	15	10	20	-	-	5
HEPTAGENIIDAE	5	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	-	-	10	5	-	5	5	10	15	-	40	35	5
PHILOPOTAMIDAE	-	-	-	-	-	-	-	40	10	-	-	-	-	-
HYDROPSYCHIDAE	10	-	-	50	20	-	40	20	20	10	15	10	35	10
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	-	-	-	20	10	-	20	-	-	-	5
EMPIDIDAE	-	5	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE														
Tanypodinae	-	10	-	-	5	15	-	-	5	10	-	-	-	25
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	5	10	20	-	5	10	5	5	15	10	25	10	5	10
Eukiefferiella/ Tvetenia	-	-	-	-	-	-	-	-	-	-	20	10	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-	-	5	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	-	-	-	10	20	40	10	5	10	-	-	-	-	5
Tanytarsini	-	-	-	10	10	-	5	-	-	-	-	-	-	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100

ISD Models (cont'd.)

	SEWAGE EFFLUENT, ANIMAL WASTES									
	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	-	-	-	-
OLIGOCHAETA	5	35	15	10	10	35	40	10	20	15
HIRUDINEA	-	-	-	-	-	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	-	-	-
SPHAERIIDAE	-	-	-	10	-	-	-	-	-	-
ASELLIDAE	5	10	-	10	10	10	10	50	-	5
GAMMARIDAE	-	-	-	-	-	10	-	10	-	-
Isonychia	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	10	5	-	-	-	-	5	-
HEPTAGENIIDAE	10	10	10	-	-	-	-	-	-	-
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	5	-
Caenis/Tricorythodes	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-
Optioservus	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-
Stenelmis	15	-	10	10	-	-	-	-	-	-
PHILOPOTAMIDAE	-	-	-	-	-	-	-	-	-	-
HYDROPSYCHIDAE	45	-	10	10	10	-	-	10	5	-
HELICOPSYCHIDAE/ BRACHYCENTRIDAE/ RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-
SIMULIIDAE	-	-	-	-	-	-	-	-	-	-
Simulium vittatum	-	-	-	25	10	35	-	-	5	5
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE										
Tanypodinae	-	5	-	-	-	-	-	-	5	5
Cardiocladius	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	-	10	15	-	-	10	10	-	5	5
Eukiefferiella/ Tvetenia	-	-	10	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	10	-	-	60
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	10	60	-	30	10	5	5
Tanytarsini	10	10	10	10	-	-	-	10	40	-
TOTAL	100	100	100	100	100	100	100	100	100	100

ISD Models (cont'd.)

	SILTATION					IMPOUNDMENT									
	A	B	C	D	E	A	B	C	D	E	F	G	H	I	J
PLATYHELMINTHES	-	-	-	-	-	-	10	-	10	-	5	-	50	10	-
OLIGOCHAETA	5	-	20	10	5	5	-	40	5	10	5	10	5	5	-
HIRUDINEA	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
GASTROPODA	-	-	-	-	-	-	-	10	-	5	5	-	-	-	-
SPHAERIIDAE	-	-	-	5	-	-	-	-	-	-	-	-	5	25	-
ASELLIDAE	-	-	-	-	-	-	5	5	-	10	5	5	5	-	-
GAMMARIDAE	-	-	-	10	-	-	-	10	-	10	50	-	5	10	-
Isonychia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Caenis/Tricorythodes	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Psephenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Optioservus	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
Promoresia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenelmis	5	10	10	5	20	5	5	10	10	-	5	35	-	5	10
PHILOPOTAMIDAE	-	-	-	-	-	5	-	-	5	-	-	-	-	-	30
HYDROPSYCHIDAE	25	10	-	20	30	50	15	10	10	10	10	20	5	15	20
HELICOPSYCHIDAE/ BRACHYCENTRIDAE / RHYACOPHILIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
SIMULIIDAE	5	10	-	-	5	5	-	5	-	35	10	5	-	-	15
EMPIDIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHIRONOMIDAE															
Tanypodinae	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
Cardiocladius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cricotopus/ Orthocladius	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
Eukiefferiella/ Tvetenia	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
Parametriocnemus	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Chironomus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum aviceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polypedilum (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100