New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Alplaus Kill

Biological Assessment

2005 Survey

New York State
Department of Environmental Conservation
Region 1

George E. Pataki, Governor   Denise M. Sheehan, Commissioner

Alplaus Kill

BIOLOGICAL ASSESSMENT

Mohawk River Basin
Saratoga and Schenectady Counties, New York

Survey date: July 14, 2005
Report date: February 22, 2006

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CONTENTS

Stream: Alplaus Kill, Saratoga and Schenectady Counties, New York

Reach: Galway to Alplaus, New York

NYS Drainage Basin: Mohawk River

Background:

The Stream Biomonitoring Unit sampled the Alplaus Kill in Saratoga County, New York, on July 14, 2005. The purpose of the sampling was to assess overall water quality and establish baseline data for comparison with future results.

In riffle areas at seven sites, a traveling kick sample for macroinvertebrates was taken using methods 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 a 100-specimen subsample from each site. Macroinvertebrate community parameters used in the determination of water quality included species richness, biotic index, EPT richness, and percent model affinity (see Appendices II and III). Expected variability of results is stated in Smith and Bode (2004). Table 2 provides a listing of sampling sites and Table 3 provides a listing of all macroinvertebrate species collected in the present survey. This is followed by macroinvertebrate data reports, including raw data from each site. Fish communities were also sampled, using methods described in Appendix XII. Expanded habitat analysis was also performed at all sites.

Results and Conclusions:

1. Water quality in the Alplaus Kill was assessed as slightly impacted at all sites, based on resident macroinvertebrate communities. Nutrient enrichment was the primary factor affecting the fauna.

2. The Nutrient Biotic Index, recently developed by Smith (2005) to evaluate levels of nutrient enrichment, was included in the Biological Assessment Profile for the first time in this report. The index showed eutrophic conditions at most sites.

3. Fish community longitudinal trends were well correlated with habitat scores and metrics based on macroinvertebrate data.

Discussion:

The Alplaus Kill originates north of West Charlton in Saratoga County, New York, and flows approximately 19 miles in a southeasterly direction before flowing into the Mohawk River at Alplaus. The stream is classified as follows:

- from the mouth to Route 50 at Burnt Hills: B
- from Route 50 to Tributary 19, 0.2 miles south of West Charlton: B(T)
- from Tributary 19 to source: B

Waters classified as B have as their best use swimming, fishing, and fish propagation. The Alplaus Kill is stocked annually with rainbow trout (see the NYSDEC website http://www.dec.state.ny.us/website/dfwmr/fish/stoksara.html).

The purpose of the present study was to assess overall water quality and establish baseline data for comparison to future results. The Alplaus Kill was previously sampled by the NYSDEC Stream Biomonitoring Unit in 2000 and 2001 at the Glenridge site (Station-6), and was assessed both times as non-impacted. The 2000 assessment was based on a field-assessed sample, and the 2001 assessment was based on a laboratory-processed sample. Based on Impact Source Determination, nutrient enrichment was also indicated for the 2001 sample.

In the present study water quality in the Alplaus Kill was assessed as slightly impacted at all seven sites from West Charlton to Alplaus (Figure 1). Longitudinal trends show greater impact near the source, best water quality at Charlton (Station-3), and slightly declining water quality toward the mouth. Resident macroinvertebrate communities included clean-water stoneflies and mayflies, but were heavily dominated by riffle beetles, which feed on epilithic algae (occurring on rock surfaces). Impact Source Determination (Table 1) indicated nutrient enrichment at all sites, and Nutrient Biotic Index (NBI) values (see Macroinvertebrate Data Reports) were nearly all in the eutrophic range.

NBI, a metric recently developed by Smith (2005) to evaluate levels of nutrient enrichment, is included in the Biological Assessment Profile for the first time in this report. Overall water quality assessments are thus based on the average of five metrics. Since NBI values denote nutrient enrichment at all sites on the Alplaus Kill, the overall assessment is lowered somewhat. Applying NBI values to the 2001 data would still yield a non-impacted assessment.

Nutrient enrichment appears to be the primary factor controlling water quality in the Alplaus Kill. Even the most upstream site (Station-1), less than 3 miles from the stream's source, displayed facultative species, rather than sensitive headwater species. Upstream agricultural land use accounts for the nutrient-enriched community found at this site. The agricultural and suburban nature of the watershed circumscribes the water quality of the stream for its entire length (Figures 2, 4). The presence of clean-water stoneflies is a remaining pollution-sensitive indicator in the stream. The stonefly *Agnetina capitata*, found at all riffle sites, could be monitored in future studies of the Alplaus Kill as a clean-water indicator whose continued presence reflects acceptable water quality in the stream.

Land use types were was calculated for the seven sites using National Land Cover Dataset 1992 (Figure 2, also see USGS website, landcover.usgs.gov/natllandcover.asp), and is likely a major determinant of water quality in the Alplaus Kill. Total forested area generally decreased downstream and was highest at Station-3, which received the highest overall assessment. Total residential area increased downstream (Figure 2) and was highest at Station-7, which received the poorest NBI value (Figure 1). Total agricultural area generally decreased downstream and was highest at Station-2, which received the lowest overall assessment, and the second poorest NBI value.

Habitat assessments were performed at all sites, using the methods described in the EPA Rapid Bioassessment Protocols (Barbour et al., 1999). Scores ranged from 144 to 170, out of a possible 200. Habitat score trends generally followed those for macroinvertebrate and fish community assessments, being lowest at Station-1 and highest at Station-3 (Figure 3).

Fish sampling was conducted at six of the Alplaus Kill sites by Douglas Carlson (NYSDEC Fisheries) at the same time as the macroinvertebrate sampling. Methods of sampling and data analysis are contained in Appendix XII. Based on metric analysis of fish community data, water quality is assessed as moderately impacted at the most upstream site (Station-1), non-impacted at the Charlton site (Station-3), and slightly impacted at all other sites. Longitudinal trends appear well correlated with those based on macroinvertebrate data (Figure 3).

Literature Cited:

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling, 1999, Rapid bioassessment protocols for use in streams and wadeable rivers: periphyton, benthic macroinvertebrates and fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water: Washington, D.C.

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.

Smith, A.J., 2005, Development of a Nutrient Biotic Index for use with benthic macroinvertebrates. Masters Thesis, SUNY Albany, 70 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.

Overview of field data:

On July 14, 2005, the Alplaus Kill at the sites sampled was 6-40 meters wide, 0.1-0.4 meters deep, and had current speeds of 60-100 cm/sec in riffles. Dissolved oxygen was 7.2-10.0 mg/l, specific conductance was 297-368 μmhos, pH was 7.3-7.9 and the temperature was 20.7-24.0 °C (69-75 °F). Measurements for each site are found on the field data summary sheets.

Figure 1. Biological Assessment Profile (BAP) of metric values, Alplaus Kill, 2005. Values are plotted on a normalized scale of water quality. The line connects the mean of the five values for each site, representing species richness (SPP), EPT richness (EPT), Hilsenhoff Biotic Index (HBI), Percent Model Affinity (PMA), and Nutrient Biotic Index (NBI). See Appendix IV for more complete explanation.

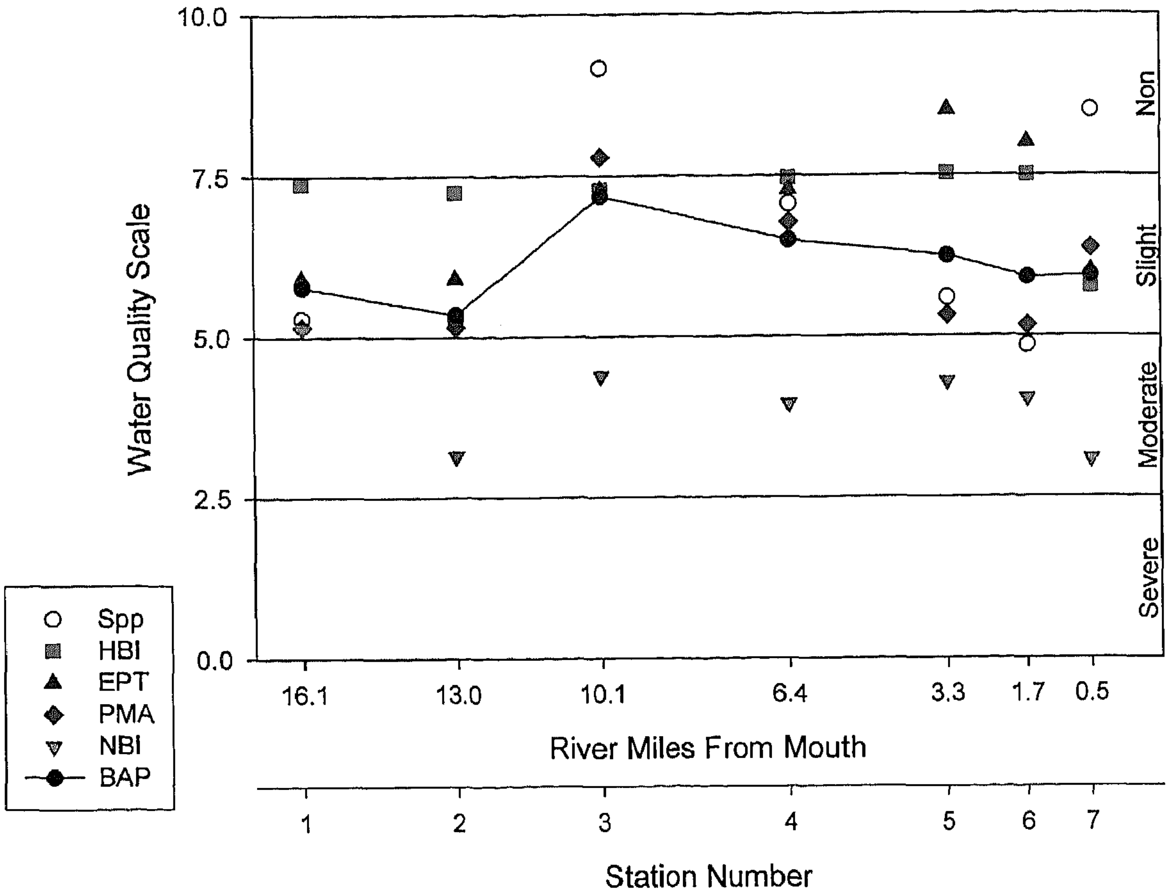


Figure 2. Percent land use composition, Alplaus Kill. General downstream trends suggest increasing residential and commercial land use, and decreasing forest and agricultural land use.

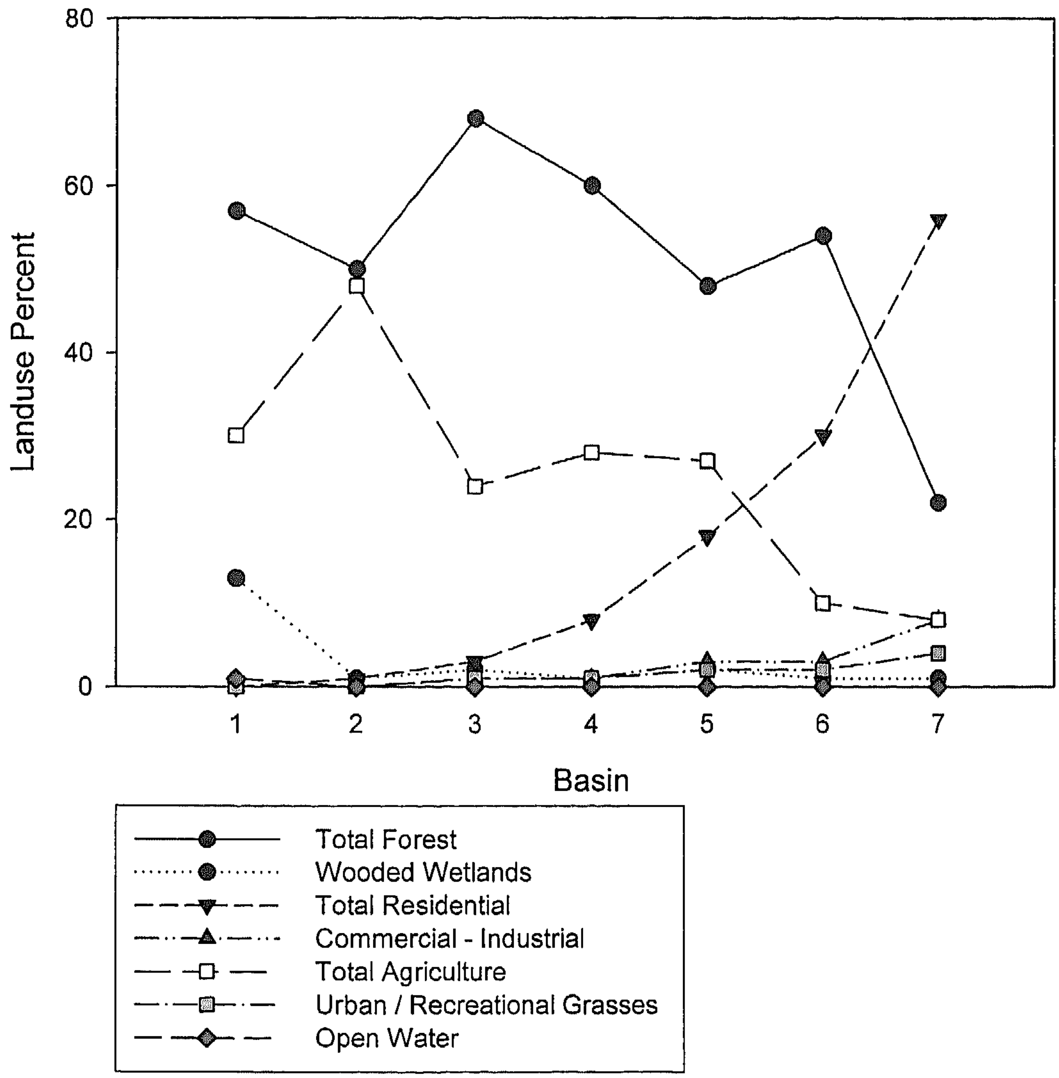


Figure 3. Biological Assessment Profile (BAP) using 4 metrics vs. 5 metrics, Fish Assessment Profile (FAP) and Habitat (HAB) scores, Alplaus Kill, 2005. A 4-metric BAP is composed of species richness, Hilsenhoff Biotic Index, Percent Model Affinity, and EPT richness. A 5-metric BAP is composed of species richness, Hilsenhoff Biotic Index, Percent Model Affinity, EPT richness, and Nutrient Biotic Index.

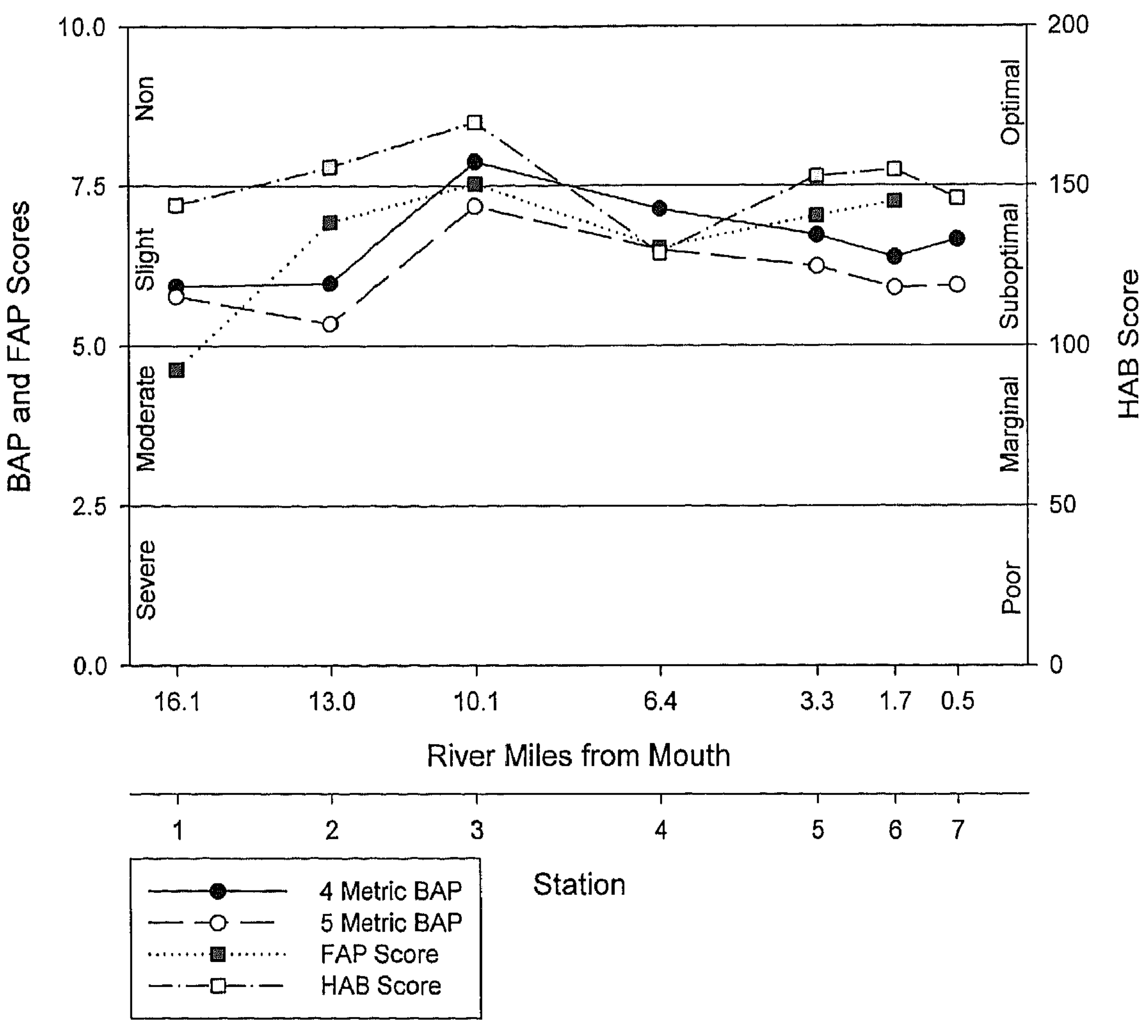


Table 1. Impact Source Determination, Alplaus Kill, 2005. Numbers represent percent similarity to community type models for each impact category. Highest similarities at each station are shaded. Similarities less than 50% are less conclusive. Highest numbers represent probable type of impact. See Appendix X for further explanation.

	Station					
Community Type	01	02	03	04	05	06
Natural: minimal human impacts	47	49	44	51	57	51
Nutrient enrichment	62	69	45	59	56	67
Toxic: industrial, municipal, or urban run-off	46	52	36	44	45	48
Organic: sewage, animal wastes	34	44	30	32	32	31
Complex: municipal and/or industrial	46	42	22	25	36	28
Siltation	36	53	43	38	43	43
Impoundment	52	57	43	49	45	52

STATION	COMMUNITY TYPE
ALPL-01	Nutrients
ALPL-02	Nutrients
ALPL-03	Natural, Nutrients, Siltation, Impoundment
ALPL-04	Nutrients
ALPL-05	Natural, Nutrients
ALPL-06	Nutrients

Table 2. Station Locations for the Alplaus Kill, Saratoga and Schenectady Counties, New York.

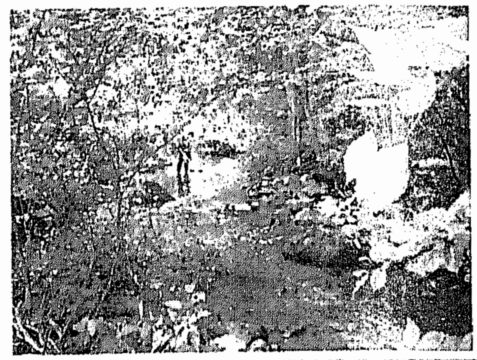
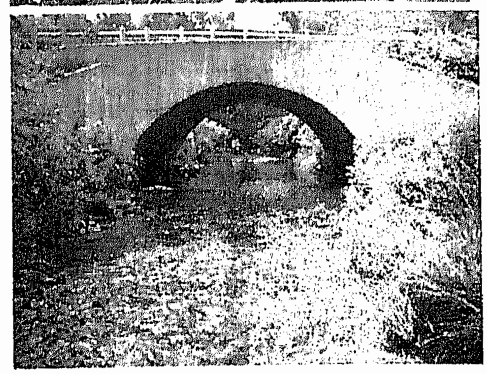
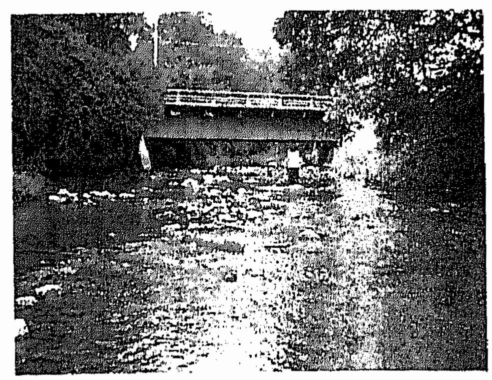
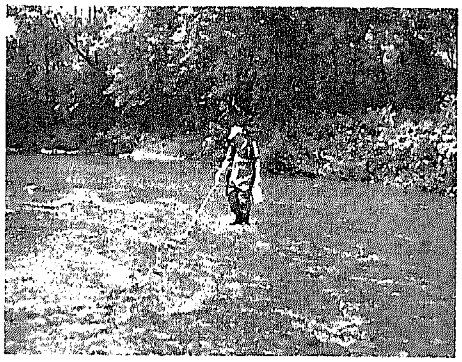
STATION	LOCATION	
ALPL-01	West Charlton, NY, below Route 67 latitude 42° 58' 28" longitude 74° 01' 12" 16.1 river miles above mouth	
ALPL-02	Charlton, NY, above Charlton Road latitude 42° 56' 16" longitude 74° 00' 23" 12.9 river miles above mouth	
ALPL-03	Charlton, NY below Swaggertown Road latitude 42° 55' 29"; longitude 73° 58' 14" 9.9 river miles above mouth	
ALPL-04	East Glenville, NY above Van Vorst Road latitude 42° 54' 19" longitude 73° 55' 08" 6.2 river miles above mouth	[no photograph available]
ALPL-05	Burnt Hills, NY at end of Rustic Road latitude:42° 53' 15" longitude 73° 53' 47" 3.0 river miles above mouth	

Table 2. Station Locations for the Alplaus Kill, Saratoga and Schenectady Counties, New York, cont'd.

ALPL-06 Glenridge, NY
above Glenridge Road bridge
latitude 42° 52' 02"
longitude 73° 54' 10"
1.5 river miles above mouth



ALPL-07 Alplaus, NY
at Alplaus Avenue bridge.
latitude 42° 51' 17"
longitude 73° 54' 12"
0.2 river miles above mouth

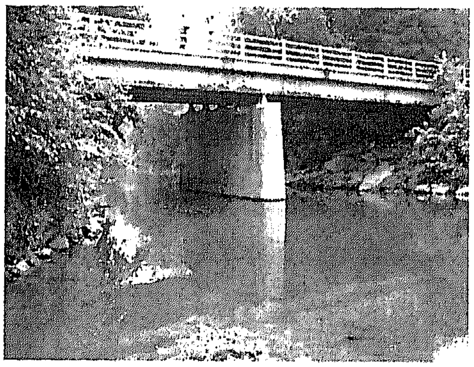


Fig. 4. Alplaus Kill Watershed Overview

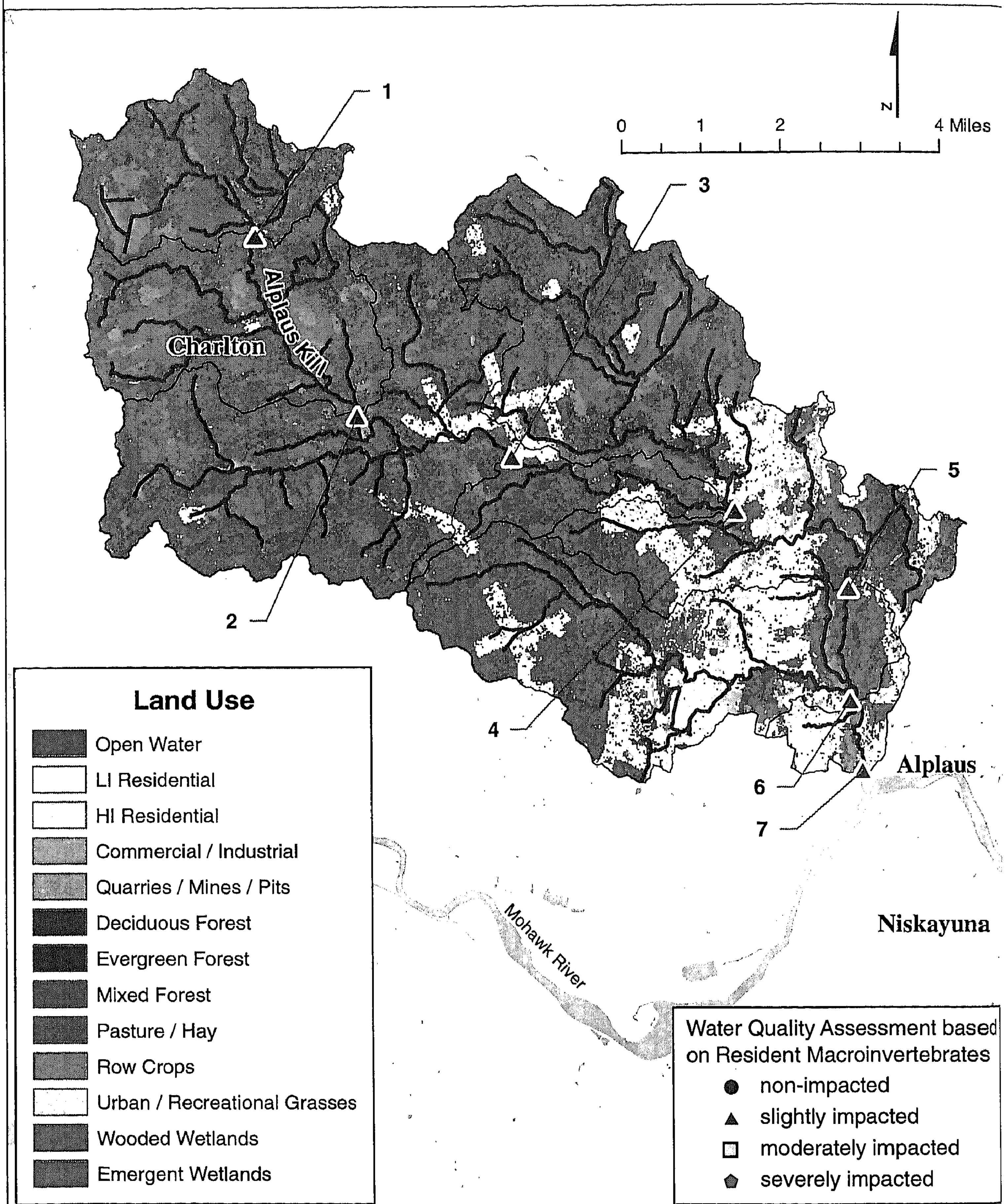


Figure 5a | Site Location Map | Alplaus Kill

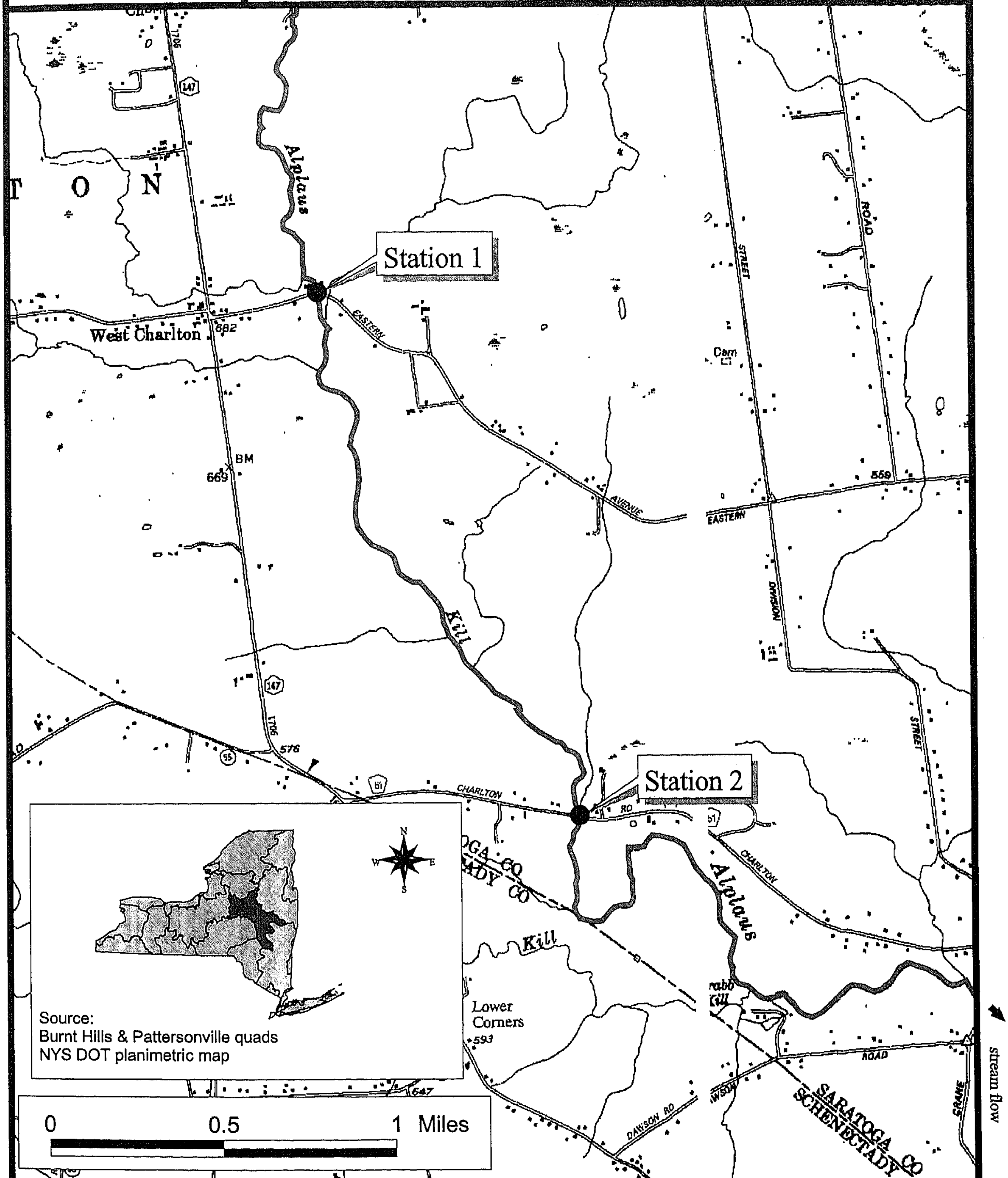


Figure 5b	Site Location Map	Alplaus Kill

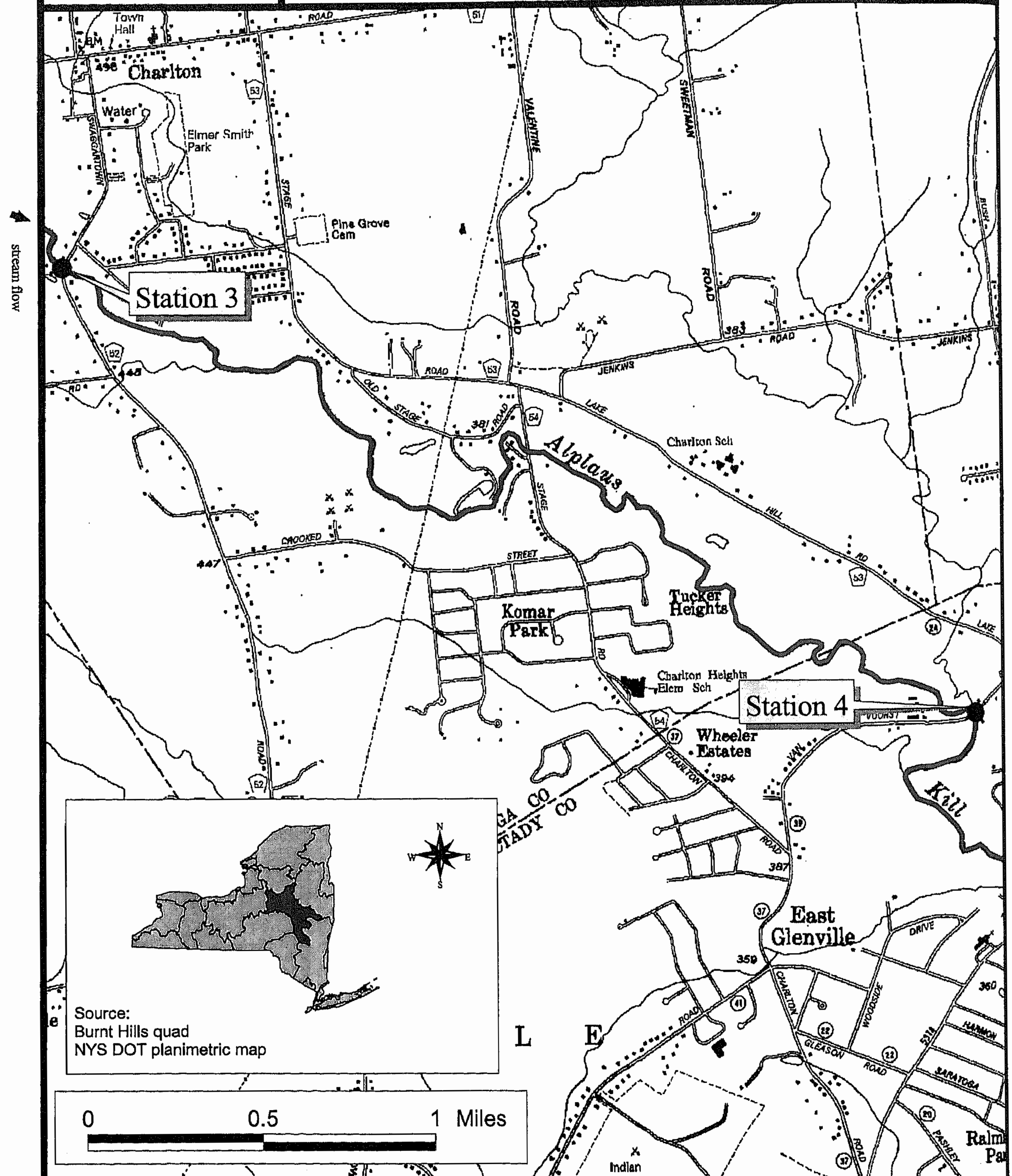
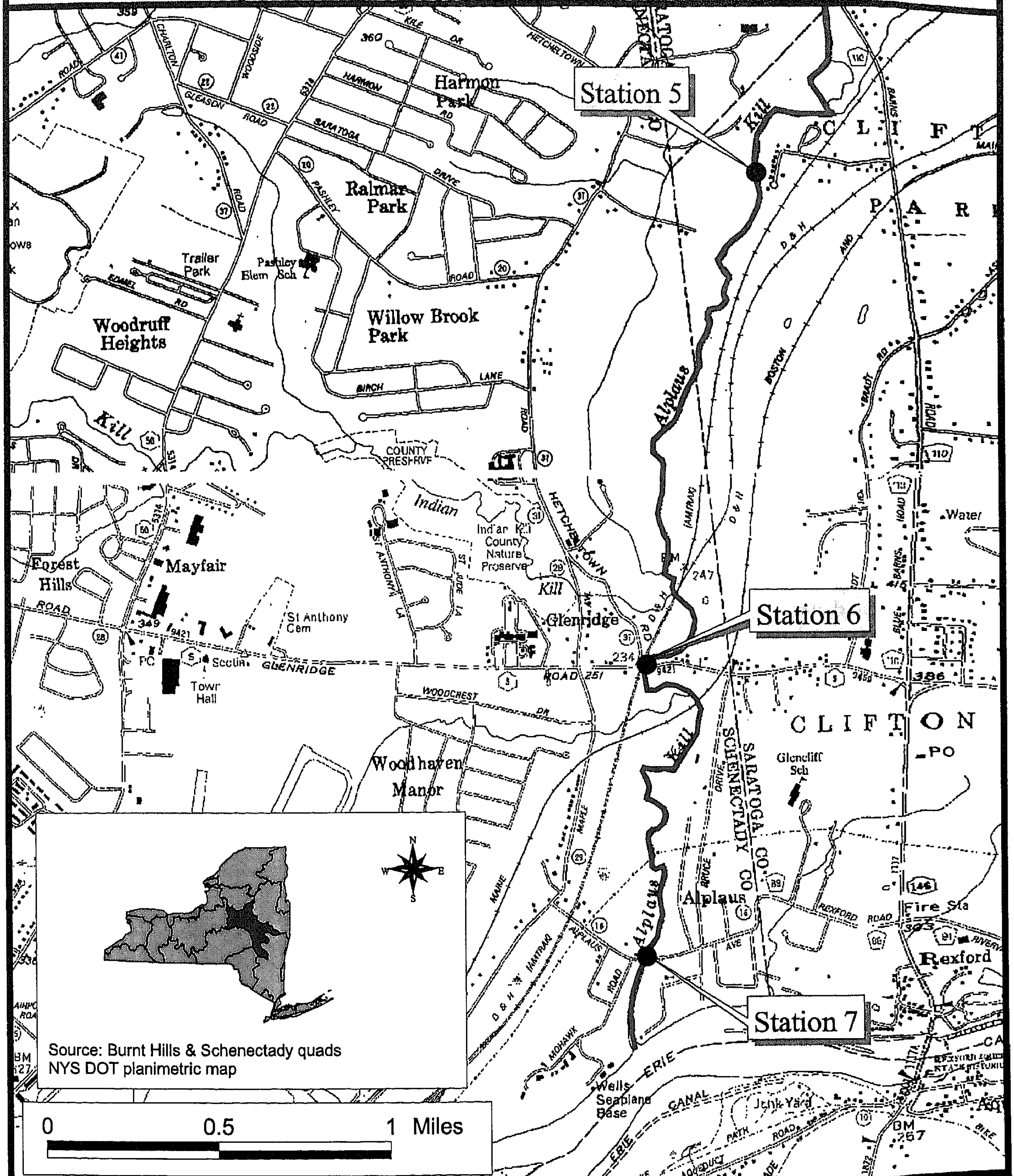


Figure 5c | Site Location Map | Alplaus Kill



stream flow

Table 3. Fish collected in the Alplaus Kill, July 14, 2005.

	Station					
Fish species	1	2	3	4	5	6
rainbow trout		1				
redfin pickerel						1
cutlip minnow		4	1			
golden shiner			1			
common shiner	11	6	15	15	1	
spotfin shiner					10	
bluntnose minnow		1	11			
eastern blacknose dace	9	33	45	5		
longnose dace			5	10		
creek chub	60	32	19	22		
fallfish					2	
white sucker	8	6	8			
brook stickleback			1			
rockbass				4		
pumpkinseed	6	1	15		2	1
bluegill					1	
smallmouth bass					14	
largemouth bass	1	1	5	2		
fantail darter					6	3
tessellated darter			2	12		
logperch					1	
Individuals	95	85	128	70	37	5
Species richness	6	9	12	7	9	3
Weighted richness	6	9	10	5	7	1
% Non-tol. Individuals	28	54	70	69	70	100
% Non-tol. Species	67	67	67	86	67	100
PMA	30	66	64	56	74	80
Fish Assessment Profile	4.63	6.93	7.53	6.53	7.03	7.25

TABLE 4. Macroinvertebrate Species Collected in the Alplaus Kill, Saratoga County, NY, 2005.

OLIGOCHAETA
TUBIFICIDA
Enchytraeidae
Undetermined Enchytraeidae
Tubificidae
Undetermined Tubificidae w/o cap. setae
HIRUDINEA
Undetermined Hirudinea
MOLLUSCA
GASTROPODA
Physidae
Physella sp.
Ancylidae
Ferrissia sp.
ARTHROPODA
CRUSTACEA
DECAPODA
Cambaridae
Undetermined Cambaridae
INSECTA
EPHEMEROPTERA
Isonychiidae
Isonychia bicolor
Baetidae
Acentrella sp.
Baetis flavistriga
Baetis intercalaris
Centroptilum sp.
Heptageniidae
Stenonema sp.
Leptophlebiidae
Undetermined Leptophlebiidae
Caenidae
Caenis sp.
PLECOPTERA
Perlidae
Agnetina capitata
Paragnetina media
ODONATA
Gomphidae
Gomphus sp.
COLEOPTERA
Psephenidae
Psephenus herricki
Elmidae
Optioservus trivittatus
Optioservus sp.
Stenelmis crenata
Stenelmis sp.
MEGALOPTERA
Corydalidae
Nigronia serricornis
Sialidae
Sialis sp.
TRICHOPTERA
Polycentropodidae
Neureclipsis sp.
Philopotamidae
Chimarra aterrima?
Chimarra obscura
Psychomyiidae
Psychomyia flavida
Hydropsychidae
Cheumatopsyche sp.
Hydropsyche betteni
Hydropsyche bronta
Hydropsyche morosa
Hydropsyche slossonae
Hydropsyche sparna
Glossosomatidae
Glossosoma sp.
Helicopsychidae
Helicopsyche borealis
DIPTERA
Tipulidae
Antocha sp.
Dicranota sp.
Hexatoma sp.
Simuliidae
Simulium tuberosum
Simulium sp.
Athericidae
Atherix sp.
Empididae
Hemerodromia sp.
Chironomidae
Ablabesmyia mallochi
Thienemannimyia gr. spp.
Pagastia orthogonia
Cricotopus bicinctus
Cricotopus fugax
Cricotopus tremulus gr.
Cricotopus trifascia gr.
Cricotopus vierriensis
Eukiefferiella devonica gr.
Lopescladius sp.
Parachaetocladius sp.
Parametriocnemus lundbecki
Rheocricotopus robacki
Tvetenia vitracies
Chironomus sp.
Cryptochironomus fulvus gr.
Microtendipes pedellus gr.
Phaenopsectra dyari
Polypedilum aviceps
Polypedilum fallax gr.
Polypedilum flavum
Polypedilum illinoense
Cladotanytarsus
Rheotanytarsus exiguus gr.
Tanytarsus curticornus
Tanytarsus glabrescens gr.
Tanytarsus guerlus gr.

Macroinvertebrate Data Report: Raw Data

STREAM SITE:	Alplaus Kill, Station ALPL- 01
LOCATION:	West Charlton, NY, downstream of Route 67 bridge
DATE:	14 July 2005
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 organisms

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Undet. Tubificidae w/o cap. setae	1
HIRUDINEA			
	Glossiphoniidae	Undetermined Hirudinea	1
ARTHROPODA			
CRUSTACEA			
DECAPODA	Cambaridae	Undetermined Cambaridae	2
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	5
		Baetis intercalaris	6
	Leptophlebiidae	Undetermined Leptophlebiidae	1
PLECOPTERA	Perlidae	*Agnetina capitata*	3
COLEOPTERA	Psephenidae	*Psephenus herricki*	3
	Elmidae	*Optioservus trivittatus*	4
		Stenelmis crenata	31
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	3
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	16
	Hydropsychidae	*Cheumatopsyche sp.*	11
		Hydropsyche betteni	1
DIPTERA	Tipulidae	*Dicranota sp.*	6
		Hexatoma sp.	1
	Athericidae	*Atherix sp.*	1
	Chironomidae	*Polypedilum flavum*	3
		Tanytarsus curticornus gr.	1

SPECIES RICHNESS:	19 (good)
BIOTIC INDEX:	4.59 (good)
EPT RICHNESS:	7 (good)
MODEL AFFINITY:	50 (good)
NUTRIENT INDEX:	5.95 (good)
ASSESSMENT:	slightly impacted (5.78)

DESCRIPTION: This upstream location was at Route 67, north of West Charlton. The macroinvertebrate community contained a full complement of orders, dominated by beetles and caddisflies. Slight impact from nutrient enrichment was indicated.

STREAM SITE: Alplaus Kill, Station ALPL- 02
LOCATION: Charlton, NY, above Charlton Road bridge
DATE: 14 July 2005
SAMPLE TYPE: Kick sample
SUBSAMPLE: 100 organisms

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	4
		Baetis intercalaris	4
PLECOPTERA	Perlidae	*Agnetina capitata*	4
COLEOPTERA	Psephenidae	*Psephenus herricki*	5
	Elmidae	*Optioservus sp.*	5
		Stenelmis crenata	27
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	2
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	2
	Psychomyiidae	*Psychomyia flavida*	1
	Hydropsychidae	*Hydropsyche bronta*	22
		Hydropsyche slossonae	3
DIPTERA	Tipulidae	*Antocha sp.*	2
		Dicranota sp.	5
		Hexatoma sp.	1
	Simuliidae	*Simulium tuberosum*	1
	Athericidae	*Atherix sp.*	4
	Chironomidae	*Tvetenia vitracies*	3
		Microtendipes pedellus gr.	1
		Polypedilum flavum	3
		Polypedilum illinoense	1

SPECIES RICHNESS: 20 (good)
BIOTIC INDEX: 4.70 (good)
EPT RICHNESS: 7 (good)
MODEL AFFINITY: 50 (good)
NUTRIENT INDEX: 6.74 (poor)
ASSESSMENT: slightly impacted (5.35)

DESCRIPTION: The kick sample was taken upstream of the Charlton Road bridge near Charlton. The macroinvertebrate community was similar to that at Station-1, dominated by algal-scraping riffle beetles and filter-feeding caddisflies. Water quality was similarly assessed as slightly impacted. Nutrient enrichment was indicated by Impact Source Determination and the Nutrient Biotic Index.

STREAM SITE:	Alplaus Kill, Station ALPL- 03
LOCATION:	Charlton, NY, above Swaggertown Rd. bridge
DATE:	14 July 2005
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 organisms

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Enchytraeidae	Undetermined Enchytraeidae	1
MOLLUSCA			
GASTROPODA	Ancylidae	*Ferrissia sp.*	1
ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Baetidae	*Baetis flavistriga*	3
		Baetis intercalaris	3
	Heptageniidae	*Stenonema sp.*	3
	Leptophlebiidae	Undetermined Leptophlebiidae	1
	Caenidae	*Caenis sp.*	5
PLECOPTERA	Perlidae	*Agnetina capitata*	2
ODONATA	Gomphidae	*Gomphus sp.*	1
COLEOPTERA	Elmidae	*Optioservus fastiditus*	3
		Stenelmis sp.	21
MEGALOPTERA	Corydalidae	*Nigronia serricornis*	3
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	2
	Polycentropodidae	*Neureclipsis sp.*	1
	Hydropsychidae	*Hydropsyche bronta*	5
	Helicopsychidae	*Helicopsyche borealis*	1
DIPTERA	Tipulidae	*Antocha sp.*	1
		Hexatoma sp.	2
	Athericidae	*Atherix sp.*	8
	Empididae	*Hemerodromia sp.*	1
	Chironomidae	*Cricotopus fugax*	1
		Cricotopus tremulus gr.	1
		Cricotopus sp.	1
		Lopescladius sp.	2
		Parachaetocladius sp.	4
		Parametriocnemus lundbecki	6
		Rheocricotopus robacki	1
		Tvetenia vitracies	1
		Microtendipes pedellus gr.	4
		Polypedilum aviceps	8
		Polypedilum flavum	1
		Rheotanytarsus exiguus gr.	2

SPECIES RICHNESS:	32 (very good)
BIOTIC INDEX:	4.68 (good)
EPT RICHNESS:	10 (good)
MODEL AFFINITY:	67 (very good)
NUTRIENT INDEX:	6.24 (poor)
ASSESSMENT:	slightly impacted (7.18)

DESCRIPTION: The kick sample was taken 100 meters above the Swaggertown Road bridge. Midges and riffle beetles dominated the macroinvertebrate community, with a high diversity of species. The overall water quality assessment was slightly impacted. Nutrient enrichment was indicated by the Nutrient Biotic Index.

Macroinvertebrate Data Report: Raw Data, cont'd

STREAM SITE:	Alplaus Kill, Station ALPL- 04
LOCATION:	East Glenville, NY, above Van Vorst Road bridge
DATE:	14 July 2005
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 organisms

ARTHROPODA			
CRUSTACEA			
DECAPODA	Cambaridae	Undetermined Cambaridae	1
INSECTA			
EPHEMEROPTERA	Baetidae	*Acentrella sp.*	3
		Baetis flavistriga	4
		Baetis intercalaris	12
PLECOPTERA	Perlidae	*Agnetina capitata*	3
		Paragnetina media	4
COLEOPTERA	Psephenidae	*Psephenus herricki*	2
	Elmidae	*Optioservus fastiditus*	13
		Stenelmis crenata	33
MEGALOPTERA	Sialidae	*Sialis sp.*	2
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	1
	Psychomyiidae	*Psychomyia flavida*	1
	Hydropsychidae	*Cheumatopsyche sp.*	1
		Hydropsyche bronta	4
	Glossosomatidae	*Glossosoma sp.*	1
DIPTERA	Tipulidae	*Antocha sp.*	2
		Hexatoma sp.	1
	Athericidae	*Atherix sp.*	2
	Chironomidae	*Cricotopus bicinctus*	1
		Cricotopus trifascia gr.	2
		Eukiefferiella devonica gr.	1
		Tvetenia vitracies	2
		Microtendipes pedellus gr.	1
		Polypedilum aviceps	2
		Polypedilum flavum	1

SPECIES RICHNESS:	25 (good)
BIOTIC INDEX:	4.53 (good)
EPT RICHNESS:	10 (good)
MODEL AFFINITY:	60 (good)
NUTRIENT INDEX:	6.42 (poor)
ASSESSMENT:	slightly impacted (6.50)

DESCRIPTION: The sample site was upstream of the Van Vorst Road bridge in East Glenville. The macroinvertebrate community was heavily dominated by algal-scraping riffle beetles, as at other sites. Based on the metrics, water quality was assessed as slightly impacted. Nutrient enrichment was indicated by Impact Source Determination and the Nutrient Biotic Index.

STREAM SITE:	Alplaus Kill, Station ALPL- 05
LOCATION:	Burnt Hills, NY, off Rustic Road
DATE:	14 July 2005
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 organisms

ARTHROPODA			
INSECTA			
EPHEMEROPTERA	Isonychiidae	*Isonychia bicolor*	1
	Baetidae	*Acentrella sp.*	3
		Baetis flavistriga	10
		Baetis intercalaris	8
	Heptageniidae	*Stenonema sp.*	2
PLECOPTERA	Perlidae	*Agnetina capitata*	1
COLEOPTERA	Psephenidae	*Psephenus herricki*	4
	Elmidae	*Optioservus sp.*	18
		Stenelmis sp.	27
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	10
		Chimarra obscura	1
	Hydropsychidae	*Cheumatopsyche sp.*	1
		Hydropsyche betteni	1
		Hydropsyche bronta	5
		Hydropsyche sparna	2
DIPTERA	Tipulidae	*Hexatoma sp.*	1
	Simuliidae	*Simulium sp.*	1
	Athericidae	*Atherix sp.*	1
	Chironomidae	*Lopescladius sp.*	2
		Polypedilum flavum	1

SPECIES RICHNESS:	20 (good)
BIOTIC INDEX:	4.48 (very good)
EPT RICHNESS:	12 (very good)
MODEL AFFINITY:	51 (good)
NUTRIENT INDEX:	6.29 (poor)
ASSESSMENT:	slightly impacted (6.24)

DESCRIPTION: The kick sample site was accessed off the end of Rustic Road near Burnt Hills. As at upstream sites, riffle beetles dominated the macroinvertebrate community and water quality was assessed as slightly impacted. Nutrient enrichment was indicated by Impact Source Determination and the Nutrient Biotic Index.

Macroinvertebrate Data Report: Raw Data, cont'd

STREAM SITE:	Alplaus Kill, Station ALPL- 06
LOCATION:	Glenridge, NY, above Glenridge Road bridge
DATE:	14 July 2005
SAMPLE TYPE:	Kick sample
SUBSAMPLE:	100 organisms

ARTHROPODA			
CRUSTACEA			
DECAPODA	Cambaridae	Undetermined Cambaridae	1
INSECTA			
EPHEMEROPTERA	Isonychiidae	*Isonychia bicolor*	1
	Baetidae	*Baetis flavistriga*	15
		Baetis intercalaris	3
	Heptageniidae	*Stenonema sp.*	1
	Caenidae	*Caenis sp.*	1
PLECOPTERA	Perlidae	*Agnetina capitata*	5
		Paragnetina media	2
COLEOPTERA	Psephenidae	*Psephenus herricki*	2
	Elmidae	*Optioservus fastiditus*	15
		Stenelmis crenata	39
TRICHOPTERA	Philopotamidae	*Chimarra aterrima?*	3
	Hydropsychidae	*Cheumatopsyche sp.*	3
		Hydropsyche bronta	5
		Hydropsyche sparna	1
DIPTERA	Athericidae	*Atherix sp.*	1
	Chironomidae	*Polypedilum aviceps*	1
		Polypedilum flavum	1

SPECIES RICHNESS:	18 (poor)
BIOTIC INDEX:	4.50 (good)
EPT RICHNESS:	11 (very good)
MODEL AFFINITY:	50 (good)
NUTRIENT INDEX:	6.39 (poor)
ASSESSMENT:	slightly impacted (5.91)

DESCRIPTION: The sampling site was 100 meters upstream of the Glenridge Road bridge in Glenridge. Algal-scraping riffle beetles dominated the macroinvertebrate community and water quality was assessed as slightly impacted. Nutrient enrichment was indicated by Impact Source Determination and the Nutrient Biotic Index.

STREAM SITE:	Alplaus Kill, Station ALPL- 07
LOCATION:	Alplaus, NY, downstream of Alplaus Avenue bridge
DATE:	14 July 2005
SAMPLE TYPE:	Kick, Sandy Streams
SUBSAMPLE:	100 organisms

ANNELIDA			
OLIGOCHAETA			
TUBIFICIDA	Tubificidae	Undet. Tubificidae w/o cap. setae	1
MOLLUSCA			
GASTROPODA			
	Physidae	*Physella sp.*	4
ARTHROPODA			
CRUSTACEA			
AMPHIPODA	Gammaridae	*Gammarus sp.*	1
INSECTA			
EPHEMEROPTERA	Baetidae	*Centroptilum sp.*	5
	Heptageniidae	*Stenonema sp.*	2
	Caenidae	*Caenis sp.*	1
PLECOPTERA	Perlidae	*Paragnetina media*	1
COLEOPTERA	Elmidae	*Optioservus trivittatus*	4
		Stenelmis crenata	5
DIPTERA	Chironomidae	*Ablabesmyia mallochi*	3
		Thienemannimyia gr. spp.	1
		Pagastia orthogonia	1
		Cricotopus bicinctus	1
		Cricotopus vierriensis	4
		Chironomus sp.	18
		Cryptochironomus fulvus gr.	4
		Microtendipes pedellus gr.	7
		Phaenopsectra dyari?	5
		Polypedilum fallax gr.	1
		Polypedilum illinoense	5
		Cladotanytarsus sp.	13
		Tanytarsus glabrescens gr.	8
		Tanytarsus guerlus gr.	5

SPECIES RICHNESS:	23 (very good)
BIOTIC INDEX:	6.54 (good)
EPT RICHNESS:	4 (good)
NCO RICHNESS:	8 (good)
NUTRIENT INDEX:	6.77 (poor)
ASSESSMENT:	slightly impacted (5.94)

DESCRIPTION: The sampling site was 50 meters downstream of the Alplaus Avenue bridge in Alplaus. The habitat differed from upstream sites, with a slow current speed and a stream bottom of sand and gravel. The sample method used was a combined kick sample and net jab, and sandy stream criteria were used to interpret the metrics. The macroinvertebrate community was heavily dominated by midges. Based on sandy stream metrics and criteria, water quality was assessed as slightly impacted. Nutrient enrichment was indicated by the Nutrient Biotic Index.

LABORATORY DATA SUMMARY

STREAM NAME: Alplaus Kill		**DRAINAGE: 12**		
DATE SAMPLED: 7/14/2005		**COUNTY: Saratoga & Schenectady**		
SAMPLING METHOD: Travelling Kick				
STATION	01	02	03	04
LOCATION	West Charlton Amsterdam Rd	Charlton Charlton Rd.	Charlton Swaggertown Rd.	East Glenville Van Vorst Rd.
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Stenelmis crenata 31 % facultative beetle	Stenelmis crenata 27 % facultative beetle	Stenelmis sp. 21 % facultative beetle	Stenelmis crenata 33 % facultative beetle
2. **Intolerant = not tolerant of poor water quality**	Chimarra aterrima? 16 % intolerant caddisfly	Hydropsyche bronta 22 % facultative caddisfly	Atherix sp. 8 % intolerant crane fly	Optioservus fastiditus 13 % intolerant beetle
3. **Facultative = occurring over a wide range of water quality**	Cheumatopsyche sp. 11 % facultative caddisfly	Psephenus herricki 5 % facultative beetle	Polypedilum aviceps 8 % facultative midge	Baetis intercalaris 12 % intolerant mayfly
4. **Tolerant = tolerant of poor water quality**	Baetis intercalaris 6 % intolerant mayfly	Optioservus sp. 5% intolerant beetle	Parametriocnemus lundbecki 6 % facultative midge	Baetis flavistriga 4 % intolerant mayfly
5.	Dicronata sp. 6 % intolerant crane fly	Dicronata sp. 5 % intolerant crane fly	Caenis sp. 5 % tolerant mayfly	Paragnetina media 4 % intolerant stone fly
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	4.0 (2.0)	8.0 (4.0)	32.0 (12.0)	10.0 (7.0)
Trichoptera (caddisflies)	28.0 (3.0)	28.0 (4.0)	9.0 (4.0)	8.0 (5.0)
Ephemeroptera (mayflies)	12.0 (3.0)	8.0 (2.0)	15.0 (5.0)	19.0 (3.0)
Plecoptera (stoneflies)	3.0 (1.0)	4.0 (1.0)	2.0 (1.0)	7.0 (2.0)
Coleoptera (beetles)	38.0 (3.0)	37.0 (3.0)	24.0 (2.0)	48.0 (3.0)
Oligochaeta (worms)	1.0 (1.0)	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)
Mollusca (clams and snails)	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)	0.0 (0.0)
Crustacea (crayfish, scuds, sowbugs)	2.0 (1.0)	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)
Other insects (odonates, diptera)	11.0 (4.0)	15.0 (6.0)	16.0 (6.0)	7.0 (4.0)
Other (Nemertea, Platyhelminthes)	1.0 (1.0)	0.0 (0.0)	2.0 (1.0)	0.0 (0.0)
SPECIES RICHNESS	19	20	32	25
BIOTIC INDEX	4.59	4.70	4.68	4.53
EPT RICHNESS	7	7	10	10
PERCENT MODEL AFFINITY	50	50	67	60
NUTRIENT BIOTIC INDEX	5.94	6.74	6.24	6.42
FIELD ASSESSMENT	Very good	Very good	Very good	Very good
OVERALL ASSESSMENT	Slightly impacted	Slightly impacted	Slightly impacted	Slightly impacted

LABORATORY DATA SUMMARY

STREAM NAME: Alplaus Kill		**DRAINAGE: 12**		
DATE SAMPLED: 7/14/2005		**COUNTY: Saratoga & Schenectady**		
SAMPLING METHOD: Travelling Kick				
STATION	05	06	07	
LOCATION	Burnt Hills Rustic Bridge Rd.	Glenridge Glenridge Rd.	Alplaus Alplaus Ave.	
DOMINANT SPECIES/%CONTRIBUTION/TOLERANCE/COMMON NAME				
1.	Stenelmis sp. 27 % facultative beetle	Stenelmis crenata 39 % facultative beetle	Chironomus sp. 18 % facultative midge	
2. **Intolerant = not tolerant of poor water quality**	Optioservus sp. 18 % intolerant beetle	Baetis flavistriga 15 % intolerant mayfly	Cladotanytarsus sp. 13 % facultative midge	
3. **Facultative = occurring over a wide range of water quality**	Baetis flavistriga 10 % intolerant mayfly	Optioservus fastiditus 15 % intolerant beetle	Tanytarsus glabrescens gr. 8 % facultative midge	
4. **Tolerant = tolerant of poor water quality**	Chimarra aterrima? 10 % intolerant caddisfly	Agnetina capitata 5 % intolerant stone fly	Microtendipes pedellus gr. 7 % facultative midge	
5.	Baetis intercalaris 8 % intolerant mayfly	Hydropsyche bronta 5 % facultative caddisfly	Centroptilum sp. 5 % intolerant mayfly	
% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	3.0 (2.0)	2.0 (2.0)	76.0 (14.0)	
Trichoptera (caddisflies)	20.0 (6.0)	12.0 (4.0)	0.0 (0.0)	
Ephemeroptera (mayflies)	24.0 (5.0)	21.0 (5.0)	8.0 (3.0)	
Plecoptera (stoneflies)	1.0 (1.0)	7.0 (2.0)	1.0 (1.0)	
Coleoptera (beetles)	49.0 (3.0)	56.0 (3.0)	9.0 (2.0)	
Oligochaeta (worms)	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)	
Mollusca (clams and snails)	0.0 (0.0)	0.0 (0.0)	4.0 (1.0)	
Crustacea (crayfish, scuds, sowbugs)	0.0 (0.0)	1.0 (1.0)	1.0 (1.0)	
Other insects (odonates, diptera)	3.0 (3.0)	1.0 (1.0)	0.0 (0.0)	
Other (Nemertea, Platyhelminthes)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	
SPECIES RICHNESS	20	20	23	
BIOTIC INDEX	4.48	4.50	6.54	
EPT RICHNESS	12	11	4	
PERCENT MODEL AFFINITY	51	50	44	
NUTRIENT BIOTIC INDEX	6.29	6.39	6.77	
FIELD ASSESSMENT	Very good	Very good	Good	
OVERALL ASSESSMENT	Slightly impacted	Slightly impacted	Slightly impacted	

FIELD DATA SUMMARY				
STREAM NAME: Alplaus Kill	DATE SAMPLED: 7/14/05			
REACH: West Charlton to Alplaus				
FIELD PERSONNEL INVOLVED: Smith, Bode				
STATION	01	02	03	04
ARRIVAL TIME AT STATION	8:38 am	9:26 am	10:12 am	10:55 am
LOCATION	West Charlton	Charlton	Charlton	East Glenville
PHYSICAL CHARACTERISTICS				
Width (meters)	8	6	15	10
Depth (meters)	0.1	0.1	0.1	0.2
Current speed (cm per sec.)	60	100	100	120
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	-	-	10
Rubble (6.35 – 25.4 cm)	40	-	-	30
Gravel (0.2 – 6.35 cm)	20	-	-	30
Sand (0.06 – 2.0 mm)	10	-	-	20
Silt (0.004 – 0.06 mm)	20	-	-	20
Embeddedness (%)	25	30	30	30
CHEMICAL MEASUREMENTS				
Temperature (° C)	22.6	20.7	21.8	21.7
Specific Conductance (umhos)	297	319	299	302
Dissolved Oxygen (mg/l)	7.2	9.2	7.3	8.1
pH	7.3	7.6	7.6	7.3
BIOLOGICAL ATTRIBUTES				
Canopy (%)	40	40	30	40
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous		X	X	X
algae – diatoms		X	X	X
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	X
Plecoptera (stoneflies)	X	X	X	X
Trichoptera (caddisflies)	X	X	X	X
Coleoptera (beetles)	X	X	X	X
Megaloptera (dobsonflies, alderflies)	X	X	X	X
Odonata (dragonflies, damselflies)		X	X	
Chironomidae (midges)	X		X	
Simuliidae (black flies)				
Decapoda (crayfish)	X	X	X	X
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)				
Other		X	X	X
FIELD ASSESSMENT	Very Good	Very Good	Very Good	Very Good

FIELD DATA SUMMARY

STREAM NAME: Alplaus Kill		DATE SAMPLED: 7/14/05		
REACH: West Charlton to Alplaus				
FIELD PERSONNEL INVOLVED: Smith, Bode				
STATION	05	06	07	
ARRIVAL TIME AT STATION	11:45 am	12:45 pm	3:15 pm	
LOCATION	Burnt Hills	Glenridge	Alplaus	
PHYSICAL CHARACTERISTICS				
Width (meters)	20	15	40	
Depth (meters)	0.2	0.2	0.4	
Current speed (cm per sec.)	120	100	<40	
Substrate (%)				
Rock (>25.4 cm, or bedrock)	10	10		
Rubble (6.35 – 25.4 cm)	40	40		
Gravel (0.2 – 6.35 cm)	20	20	40	
Sand (0.06 – 2.0 mm)	10	10	40	
Silt (0.004 – 0.06 mm)	20	20	20	
Embeddedness (%)	25	25	50	
CHEMICAL MEASUREMENTS				
Temperature (° C)	23.6	23.8	24	
Specific Conductance (umhos)	330	355	368	
Dissolved Oxygen (mg/l)	10.0	9.8	8.0	
pH	7.9	7.8	7.5	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	20	40	10	
Aquatic Vegetation				
algae – suspended				
algae – attached, filamentous	X			
algae – diatoms	X	X		
macrophytes or moss				
Occurrence of Macroinvertebrates				
Ephemeroptera (mayflies)	X	X	X	
Plecoptera (stoneflies)	X	X		
Trichoptera (caddisflies)	Xx	X		
Coleoptera (beetles)	Xx	X	X	
Megaloptera (dobsonflies, alderflies)	X	X		
Odonata (dragonflies, damselflies)				
Chironomidae (midges)	X	X	X	
Simuliidae (black flies)				
Decapoda (crayfish)	X	X		
Gammaridae (scuds)				
Mollusca (snails, clams)				
Oligochaeta (worms)		X		
Other	X	X		
FIELD ASSESSMENT	Very Good	Very Good	Good	

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 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. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The contents of the pan are poured into a U.S. No. 30 sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol.

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

E. Organism Identification. All organisms are identified to the species level whenever possible. Chironomids and oligochaetes are slide-mounted and viewed through a compound microscope; most other organisms are identified as whole specimens using a dissecting stereomicroscope. The number of individuals in each species and the total number of individuals in the subsample is recorded on a data sheet. All organisms from the subsample are archived (either slide-mounted or preserved in alcohol). 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 is the total number of species or taxa found in the 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; less than 11, severely impacted.

2. EPT Richness denotes 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 is 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. (1996). 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 is a measure of similarity to a model, non-impacted community based on percent abundance in seven major macroinvertebrate groups (Novak and Bode, 1992). Percent 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 is 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) were assigned based on nutrient optima for Total Phosphorus (listed in Smith, 2005). Ranges for the levels of impact 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.

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. NYSDEC Technical Report, 115 pages.

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 Division of Environmental Management Technical Report, 12 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.

Smith, A.J., 2005, Development of a Nutrient Biotic Index for use with benthic macroinvertebrates. Masters Thesis, SUNY Albany, 70 pages.

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. The 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.

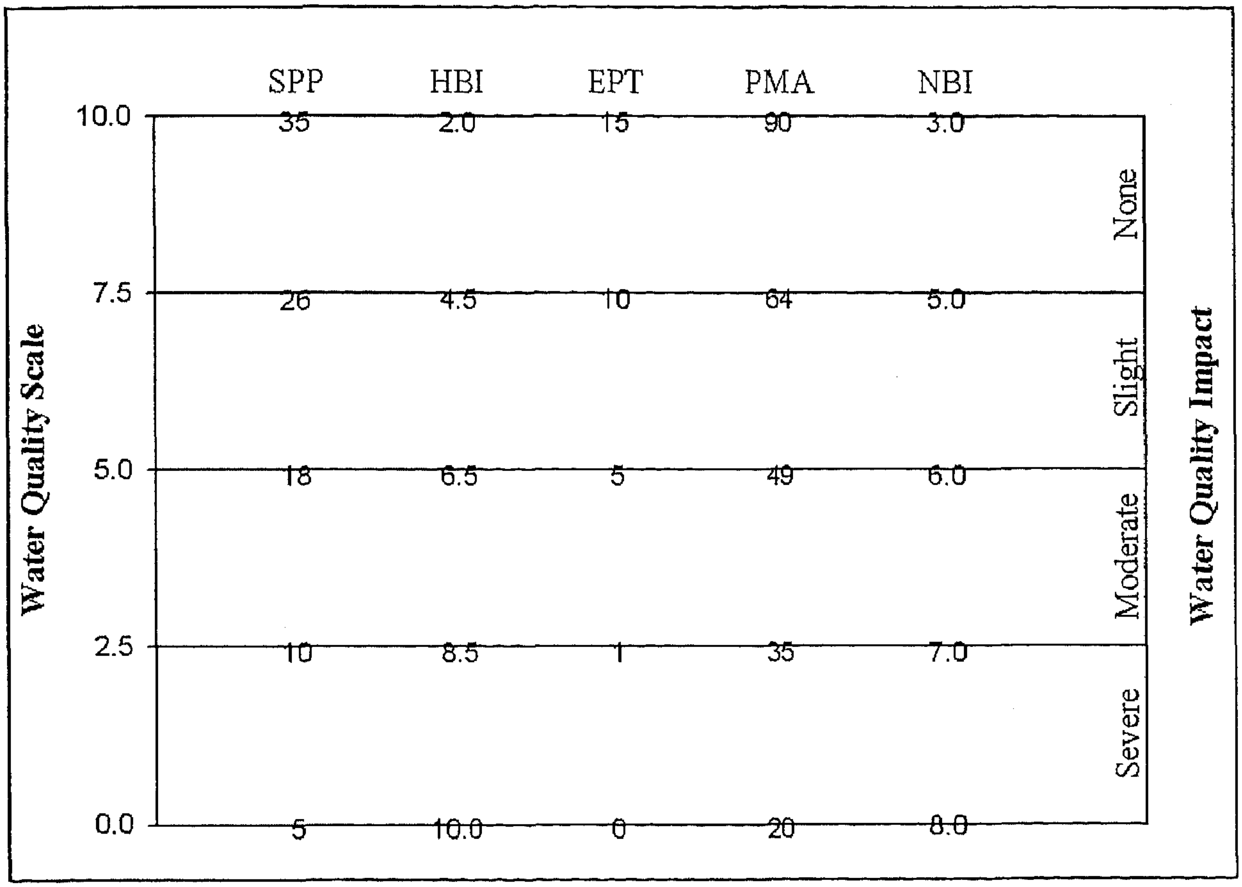
2. *Slightly impacted:* Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Species richness is usually 19-26. Mayflies and stoneflies may be restricted, with EPT richness values of 6-10. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. The 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. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 2-5. The biotic index value is 6.51-8.50. Percent model affinity is 35-49. The 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. The Nutrient Biotic Index is greater than 7.00. 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 Common 10-Scale

The Biological Assessment Profile 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.



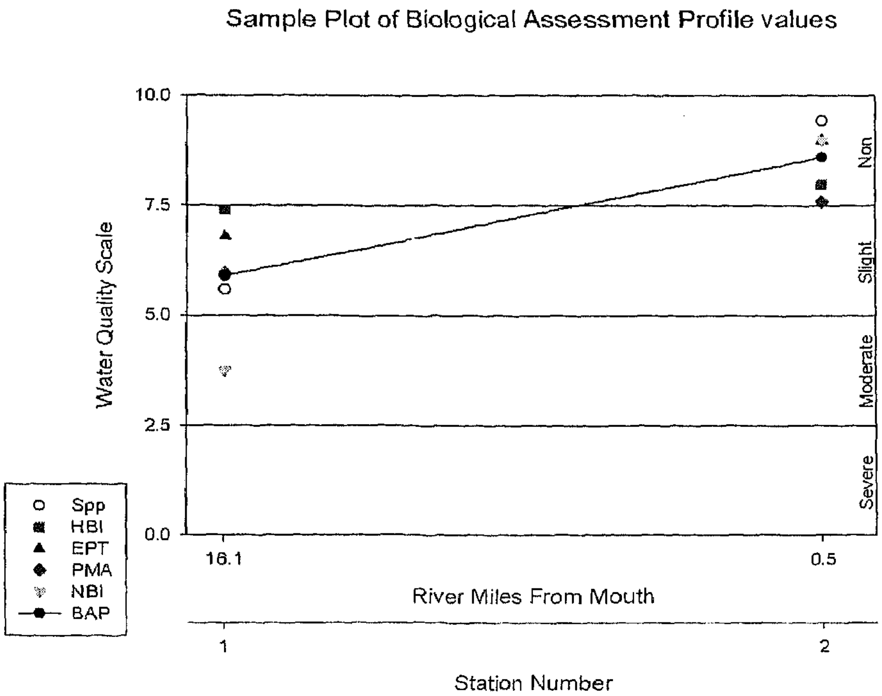
Appendix IV-B. Biological Assessment Profile: Plotting Values

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
Nutrient Biotic Index	6.50	3.75	3.50	9.00
Average		5.90 (slight)		8.61 (non-)



Appendix V.
WATER QUALITY ASSESSMENT CRITERIA

for non-navigable flowing waters

	Species Richness	Hilsenhoff Biotic Index	Nutrient Biotic Index*	EPT Value	Percent Model Affinity#	Diversity **
Non-Impacted	>26	0.00-4.50	0.00-5.00	>10	>64	>4
Slightly Impacted	19-26	4.51-6.50	5.01-6.00	6-10	50-64	3.01-4.00
Moderately Impacted	11-18	6.51-8.50	6.51-7.00	2-5	35-49	2.01-3.00
Severely Impacted	0-10	8.51-10.00	7.01-10.00	0-1	<35	0.00-2.00

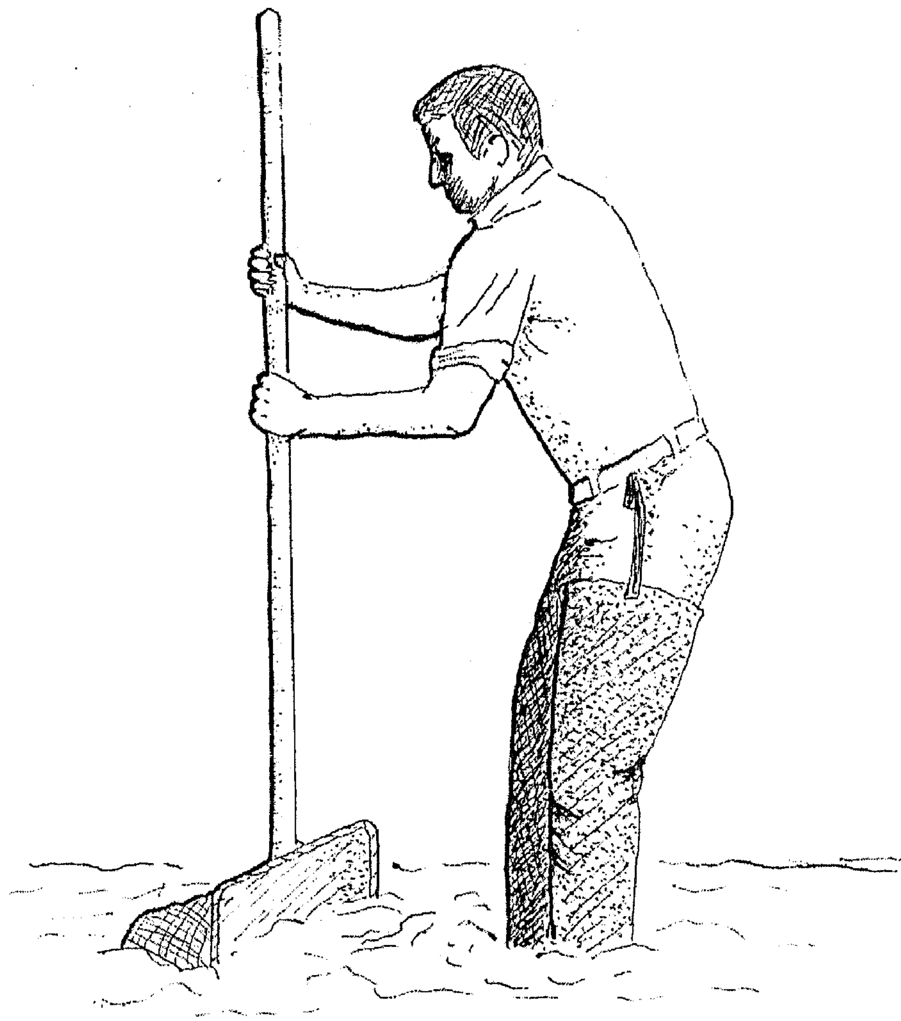
* Nutrient Biotic Index (for total phosphorus) criteria are used for traveling kick samples but not for multiplate samples.
# Percent model affinity criteria are used for traveling kick samples but not for multiplate samples.
** Diversity criteria are used for multiplate samples but not for traveling kick samples.

WATER QUALITY ASSESSMENT CRITERIA
for navigable flowing waters

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

Appendix VI.

The Traveling Kick Sample

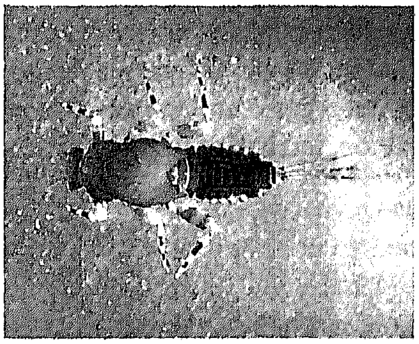


← current

Rocks and sediment in 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.

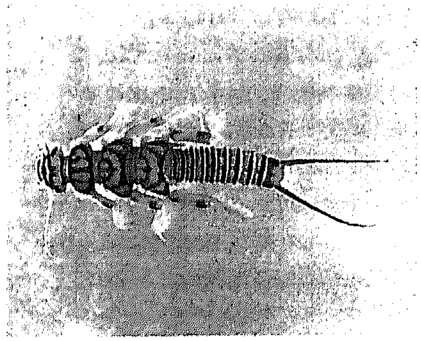
Appendix VII. A.
Aquatic Macroinvertebrates that Usually Indicate Good Water Quality

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



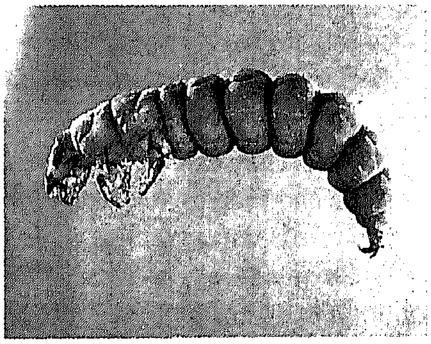
MAYFLIES

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



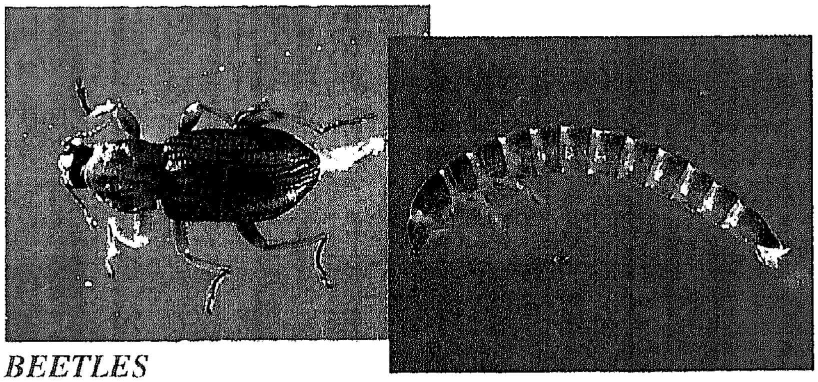
STONEFLIES

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



CADDISFLIES

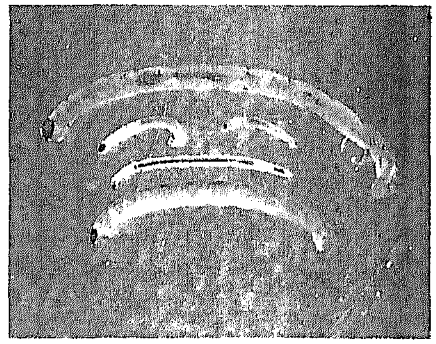
The most common beetles in streams are riffle beetles (adult and larva shown) and water pennies (not shown). Most of these require a swift current and an adequate supply of oxygen, and are generally considered clean-water indicators.



BEETLES

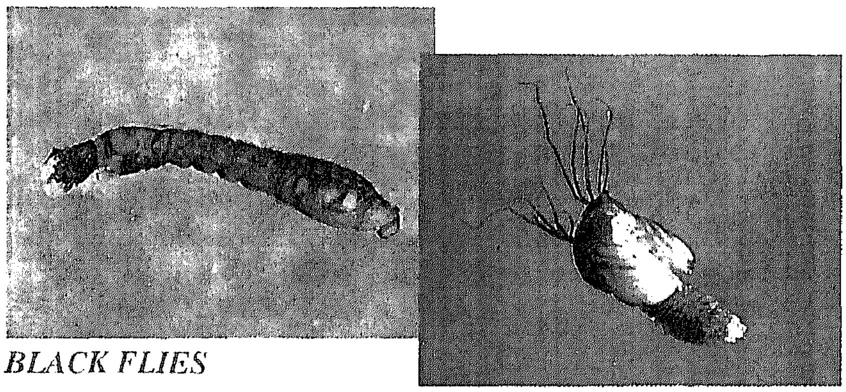
Appendix VII. B.
Aquatic Macroinvertebrates that Usually Indicate Poor Water Quality

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



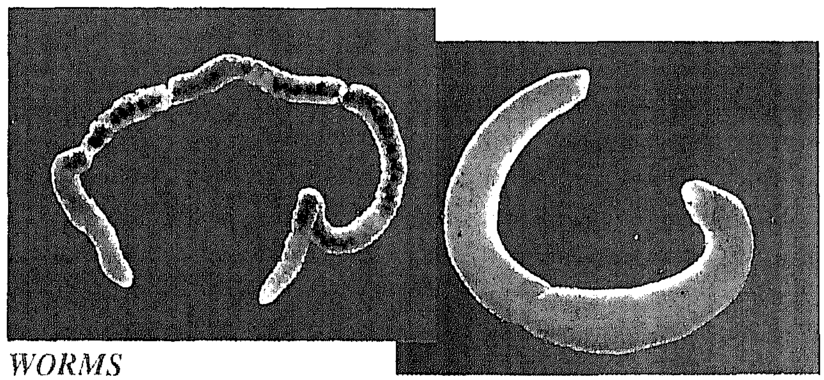
MIDGES

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



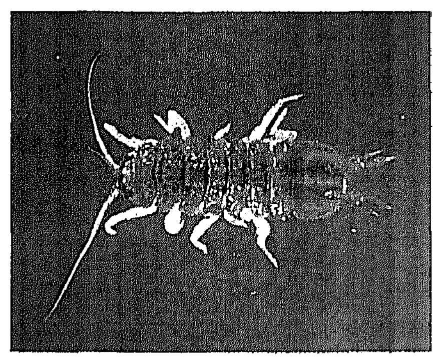
BLACK FLIES

The segmented worms include the leeches and the small aquatic 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 species of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera)in a sample or subsample

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

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

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 species in a sample or subsample

station: a sampling site on a waterbody

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

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

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. 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 TABLE
NATURAL MACROINVERTEBRATE COMMUNITY TYPE

	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 TABLE (cont.)
NONPOINT NUTRIENT ENRICHMENT IMPACTED MACROINVERTEBRATE COMMUNITY TYPE

	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 TABLE (cont.)
MACROINVERTEBRATE COMMUNITY TYPES

	MUNICIPAL/INDUSTRIAL WASTES IMPACTED								TOXICS IMPACTED					
	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 TABLE (cont.)

SEWAGE EFFLUENT, ANIMAL WASTES IMPACTED MACROINVERTEBRATE COMMUNITY TYPE

	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 TABLE (cont.)
MACROINVERTEBRATE COMMUNITY TYPES

	SILTATION IMPACTED					IMPOUNDMENT IMPACTED									
	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	-
<u>Isonychia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BAETIDAE	-	10	20	5	-	-	5	-	5	-	-	5	-	-	5
HEPTAGENIIDAE	5	10	-	20	5	5	5	-	5	5	5	5	-	5	5
LEPTOPHLEBIIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPHEMERELLIDAE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Caenis/Tricorythodes</u>	5	20	10	5	15	-	-	-	-	-	-	-	-	-	-
PLECOPTERA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Psephenus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
<u>Optioservus</u>	5	10	-	-	-	-	-	-	-	-	-	-	-	5	-
<u>Promoresia</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Stenelmis</u>	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	-	-	-	-	-	-	-	-
<u>Cardiocladius</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Cricotopus/ Orthocladius</u>	25	-	10	5	5	5	25	5	-	10	-	5	10	-	-
<u>Eukiefferiella/ Tvetenia</u>	-	-	10	-	5	5	15	-	-	-	-	-	-	-	-
<u>Parametriocnemus</u>	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
<u>Chironomus</u>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum aviceps</u> -	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>Polypedilum</u> (all others)	10	10	10	5	5	5	-	-	20	-	-	5	5	5	5
Tanytarsini	10	10	10	10	5	5	10	5	30	-	-	5	10	10	5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

APPENDIX XI. METHODS FOR CALCULATION OF THE NUTRIENT BIOTIC INDEX

Definition: The Nutrient Biotic Index (Smith, 2005) is a diagnostic measure of stream nutrient enrichment identified by macroinvertebrate taxa. The frequency of occurrences of taxa at varying nutrient concentrations allowed 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 provided 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 indicate 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 the indices [2] follows the approach of Hilsenhoff (1987).

$$\text{NBI Score}_{(TP\ or\ NO_3)} = \sum (a \times b) / c$$

Where a is equal to the number of individuals for each taxon, b is the taxon's tolerance value (either for phosphorus or nitrate), 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 status. The NBI primarily used for reporting is NBI-P.

Index	Oligotrophic	Mesotrophic	Eutrophic
NBI-P	< 5.0	> 5.0 - 6.5	> 6.0
NBI-N	< 4.5	> 4.5 - 6.0	> 6.0

References:

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

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., 2005, Development of a Nutrient Biotic Index for use with benthic macroinvertebrates. Masters Thesis, SUNY Albany, 70 pages.

APPENDIX XII. METHODS FOR ASSESSMENT OF WATER QUALITY USING FISH

A. Sampling: Sampling in wadeable streams consists of electrofishing for approximately 20 minutes, attempting to sample one pool and one riffle. A backpack electroshocker is used. All fish are identified, enumerated and released at the site.

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

1. Weighted Species Richness:. Species richness is weighted by stream width using the following provisional formula where x= richness: for stream width 1-4 meters, value= x+2; for 5-9 meters, x; for 10-20 meters, x-2; for >20 meters, x-4. Maximum value= 10.

2. Percent Non-tolerant Individuals: The percentage of total individual organisms that are species considered intolerant or intermediate to environmental perturbations; this is the inverse of percent tolerant individuals. Tolerance ratings are derived from Classification of freshwater fish species of the Northeastern United States (Halliwell et al., 1998), with the exception of blacknose dace, which are here considered intermediate rather than tolerant.

3. Percent Non-tolerant Species: The percentage of total species that are considered intolerant or intermediate to environmental perturbations.

4. Percent Model Affinity, by Trophic Class. The highest percentage similarity of a sampled fish community with any of five models of non-impacted fish communities, by trophic class, as listed in Halliwell et al. (1998). The models are:

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

Overall assessment of water quality is assigned by *profile value*. Profile value = (Weighted Species Richness + 0.1[Percent Non-tolerant Individuals] + 0.1[Percent Non-tolerant Species] + 0.1[Percent Model Affinity]) ÷ 4

Halliwell, D.B., R.W. Langdon, R.A. Daniels, J.P. Kurtenbach, and R.A. Jacobson, 1998, Classification of freshwater fish species of the Northeastern United States for use in the development of indices of biological integrity, with regional applications. Chapter 12 In: Simon, T.P., ed. Assessing the sustainability and biological integrity of water resources using fish communities. CRC Press, Inc., 671 pages.