QU.AlITY ASSURANCE WORK PLAN FOR BIOLOGICAL STREAM MONITORING IN NEW YORK STATE

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TABLE OF CONTENTS

INTRODUCTION

This document was prepared to meet QA/QC requirements for an existing environmental monitoring program. It documents the standard operating procedures and quality assurance methods of the stream Biomonitoring program, in order to assure consistency of methods and quality of data. It was prepared using the 1983 GuidaI1ce Document issued by the U. s. Environmental Protection Agency's Office of Water Regulations and Standards, and utilizes the format provided in the Guidance Document.

It is intended that this document be updated triennially to reflect changes in the program. As new techniques are researched and developed, they will be incorporated into the work plan. Additionally, inevitable changes and additions will be made to the list of species and identification references. All questions and comments on this document should be forwarded to Robert Bode, Division of Water, Room 328, NYS Department of Environmental Conservation, 50 Wolf Road, Albany, New York 12233-3503.

1. Project Name: stream Biomonitoring

2. proiect Requested By: New York state Department of Environmental Conservation

3'.; Date of Request: 1972

4~ Date of proiect Initiation: 1972

5. proiect Officer: Robert W. Bode

6. Quality Assurance Officer: Robert W. Bode

7. proiect Description

7.A. Objective and Scope Statement

The biological monitoring project was initiated in New York state in May, 1972 as mandated by the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The main objective of the project was to evaluate the relative biological health of the state's streams and rivers through the collection and analysis of macroinvertebrate communities. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit stream bottoms; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans. Analysis of macro invertebrate communities is a reliable and cost-effective approach to water quality monitoring because 1.) macroinvertebrates are very sensitive to environmental impacts, 2.) they are less mobile than fish and cannot avoid intermittent discharges, and 3.) they are relatively easy to sample and analyze.

The primary activities of the biological monitoring project are macro invertebrate community assessment and macro invertebrate tissue analysis. Macroinvertebrate community assessment utilizes macro invertebrate community parameters such as species richness and standing crop to assess overall water quality. Two primary methods are used to sample the macro invertebrate communities: the traveling kick method for wadeable riffles, and multiple-plate artificial substrate sampling for deeper waters. Macroinvertebrate tissue analysis relies on the collection of several specimens of a given macro invertebrate species and subsequent analysis of the tissues of the organisms for toxic substances. Macroinvertebrates bioconcentratemost toxics to concentrations several times that found in the water, and determination of levels yields information on levels in the aquatic food chain, since many macro invertebrates serve as primary fish food organisms.

7.B. Data Usage

The intended usage of biological monitoring data varies with the specific type of monitoring effort. The following are the primary data uses:

1. Biennial water quality reports: biological data from the Rotating Intensive Basin Survey (RIBS) sites will be included in biennial reports summarizing these monitoring efforts.

2. Intensive survey reports: data from special surveys coordinated with the intensive surveys are incorporated into intensive survey reports. These reports deal with water quality predictive models which are used in the permitting process. The special survey reports also are sent to. the regional offices for use in regional water quality management.

3. Priori ty Water Problem List: Many data are used to supplement documentation of water quality problems included on the PWP list.

4. 305 (b) Reports: many data are used to supplement documentation of water quality included in the 305 (b) reports.

5. Toxicity testing: data indicating toxic problems may be used to support further study using toxicity t~sting in cases of permit reissuance or possible enforcement action.

6. Baseline data set: all data becomes part of a baseline data set which is used for trend assessment. Future monitoring efforts compare collected data with that stored in the cumulative baseline data set to assess water quality trends over time.

7. Non-point source discharges: data which indicate impacts caused by non-point discharges are forwarded to the Bureau of Monitoring' and Assessment's list of non-point source stressed waters.

8. Compliance and enforcement uses: data which indicate significant biological impacts on aquatic life may be used as supporting evidence in violation procedures.

7.C. Monitoring Network Design and Rationale

Sampling is divided into two primary categories, routine monitoring and intensive surveys. From 1972 -1977, routine monitoring included baseline surveys of the major waterways in the State, with sampling sites located approximately every 5 miles on most systems. These large river sites were sampled almost exclusively with multiple-plate artificial substrate samplers. From 1978-1983, this survey schedule was repeated, with nearly all the same sampling sites being sampled for trend analysis.

From 1984-1986, sampling mostly consisted of intensive surveys on smaller streams. During this time the "Rapid Assessment" protocol was designed, tested, and modified, using the traveling kick sample method on wadeable streams.

In 1987 routine monitoring began on the RIBS (Rotating Intensive Basin Studies) network. This system involves an integrated sampling effort on one third of the maj or drainage basins in the state each for two years, completing all basins over a six-year period.

7.D. Monitoring Parameters and Frequency of Collection

The following parameters are collected at sampling sites:

1. Sampling site location: river or stream, station number, specific location (distance upstream or downstream of bridge, road, town, or other landmark), access.

2. Collection date and time (arrival and departure), collectors

3. Site physical parameters: width, depth, current speed, substrate type, canopy cover

4. Water chemical parameters: temperature, conductivity, dissolved oxygen, Ph

5. Biological parameters: major macroinvertebrate groups present, aquatic vegetation

6. Type of sample: e.g., multiplate, kick, organisms for tissue analysis, photograph.

7. Field assessment of water quality: based on macro invertebrate community, aquatic vegetation, chemical parameters, other indications of impact.

7.E. Parameter Table

Parameter	Sample Matrix	Method Reference
Dissolved oxygen	water	360.1*
pH	water	150.1*
Specific conductance	water	120.1*
Temperature	water	170.1*
Current speed	water	" "
Substrate type	substrate	" "
Multiplate sample	water	" "
Kick sample	substrate	" "
Organism tissue	substrate	" "

* - As documented in EPA Methods for Chemical Analysis of Water and Wastes)

** - As documented in section 12

8. proiect Fiscal Information

Listed below are resource requirements *for* the project which may be used *for* computing cost estimates.- More complete financial requirements and expenditures are available from the Bureau of Monitoring and Assessment.

8.A. Work hour estimates
1. Field sampling: 2 persons X .75 hours = 1.5 hours/site 2. Multiplate sample processing: 15 hours/sample
3. Kick sample processing: 5 hours/sample
4. Sampling travel time: actual travel time *for* surveys is dependent on distance from the main office; total travel time = 2 x time to travel to stream + .75 hours/site sampling time +.25 hours/site ave. traveling time between sites.

8.B. Expendable items required 1.
Alcohol: 30 gallons/year
2. Multiplate sample jars (4-oz): 150/year
3. Kick sample jars (1 qt.): 25/year
4. Multiplate sample wood (4' x 8' masonite):" 2 sheets/year 5. Cable *for* sampler installing (1/8 inch): 120 feet/year 6. Turnbuckles: 35/year
7. Swivel snaps: 35/year
8. Microscope slides: 9 gross/year ;
9. Mounting media: 200 ml Euparal/year, 100 ml PVL/year

8.C. Major equipment items: a complete and current inventory of equipment is maintained by the project. Major items are listed below:
1. Dissecting microscopes: 5 2. Compound microscopes: 2
3. Microscope illuminators: 5
4. Refrigerator/freezer: 1
5. Boats: 1 19-ft., 1 8-ft, 1 inflatable raft
6. Boat motors: 1 85-hp, 1 9-hp
7. Meters: pH, DO, SCT, current
8. Computers: 2 pc's with printers
9. Samplers: 2 ponars, 4 Surbers, 4 nets, 1 Hess

9. Schedule of Tasks and Products

These items are dependent on the individual activities of the project; each task/product date differs with the particular activity. Listed below is the generalized scheme followed for the majority of the activities.

9.A. Multiplate sampling
1. Sample collection: May-September
2. Sample processing: September-March
3. Data analysis, reporting: February-April

9.B. Kick sampling
1. Sample collection: July-September
2. Sample processing: July-November
3. Data analysis, reporting: October-December

10. proiect Orqanization and Responsibility

The Stream Biomonitoring unit is in. the Quality Assessment Section of the Bureau of Monitoring and Assessment, Division of Water, New York State Department of Environmental Conservation. Following is a list of project personnel and their corresponding responsibilities:

10.A. Research Scientist II: Overall
1. project coordination Overall QA
2. Sampling design
3. Performance auditing Secondary
4. laboratory analysis Data quality
5. review Reporting
6.
7.

10.B. Research scientist I:
1. Data processing activities Data
2. processing QC
3. Secondary laboratory analysis
4. Secondary data quality review
5. Secondary reporting

10.C. Laboratory technician: Sampling
1. operations
2. Sampling QC
3. Primary laboratory analysis
4. Laboratory QC
5. Secondary data quality review

11. Data Oualitv Requirements and Assessments

11. A. site selection: sampling sites are selected to be representative of stream conditions and comparable to upstream and downstream sites. Representativeness is achieved by sampling in the mainstream, rather than peripheral areas. Comparability is achieved by selecting sites with the same dominant substrate type, similar current speeds, and similar percentages of canopy cover.

11.B. Multiplate sampling: all multiplate samplers are constructed,' installed, and retrieved using specified methods (Section 12), assuring comparability between samples. Current speed is recognized as the primary stream factor necessary to be made uniform between sites for maximum comparability. Samples are tested for validity (Section 16-B) to determine if disturbance occurred during the exposure period.

11.C. Kick sampling: representativeness is achieved by sampling on a diagonal transect of the stream. Comparability is achieved by sampling for a specified time and distance (Section 12-B). comparability of current speed and substrate type between sites to the degree possible results in maximum comparability of the data.

11.D. Tissue analysis sampling: net-spinning caddisflies (Trichoptera: Hydropsychidae) and crayfish (Crustacea: Decapoda), found statewide in most flowing waters, are co~lected whenever possible for maximum comparability. Detection limits, accuracy, and QA protocols for tissue analysis are the responsibility of the analytical laboratories of the New York State Department of Health.

11.E. Organism identification: data validation procedures for organism identification given in section 16-A assure accuracy of identification. Comparability of identifications is assured through frequent comparison of identified specimens with those in the reference collection.

11.F. Dissolved oxygen: stated accuracy of meter per manual of operations is+/- 1%; stated readability is +/- .05-.1 ppm. All samples are taken at 1 meter unless otherwise indicated; profile sampling is performed if warranted. Calibration procedures are given in section 14-A. Time of day is always noted and is taken into account for representativeness and comparability.

11.G. pH: stated ~ccuracy of meter per manual of operations is +/- .02 pH; repeatability is +/- .015 pH. All samples are taken at 1 meter unless otherwise indicated; profile sampling is performed if warranted. Meter is standardized daily or as needed as given in section 14-B.

11.H. Conductivity: stated accuracy of meter per manual of operations is +/- 2.5-3.0%; readability is +/- .5%. All samples are taken at 1 meter unless otherwise indicated; profile sampling

is performed if warranted. The meter is standardized as given in Section 14-C.

12. Samplinq Procedures

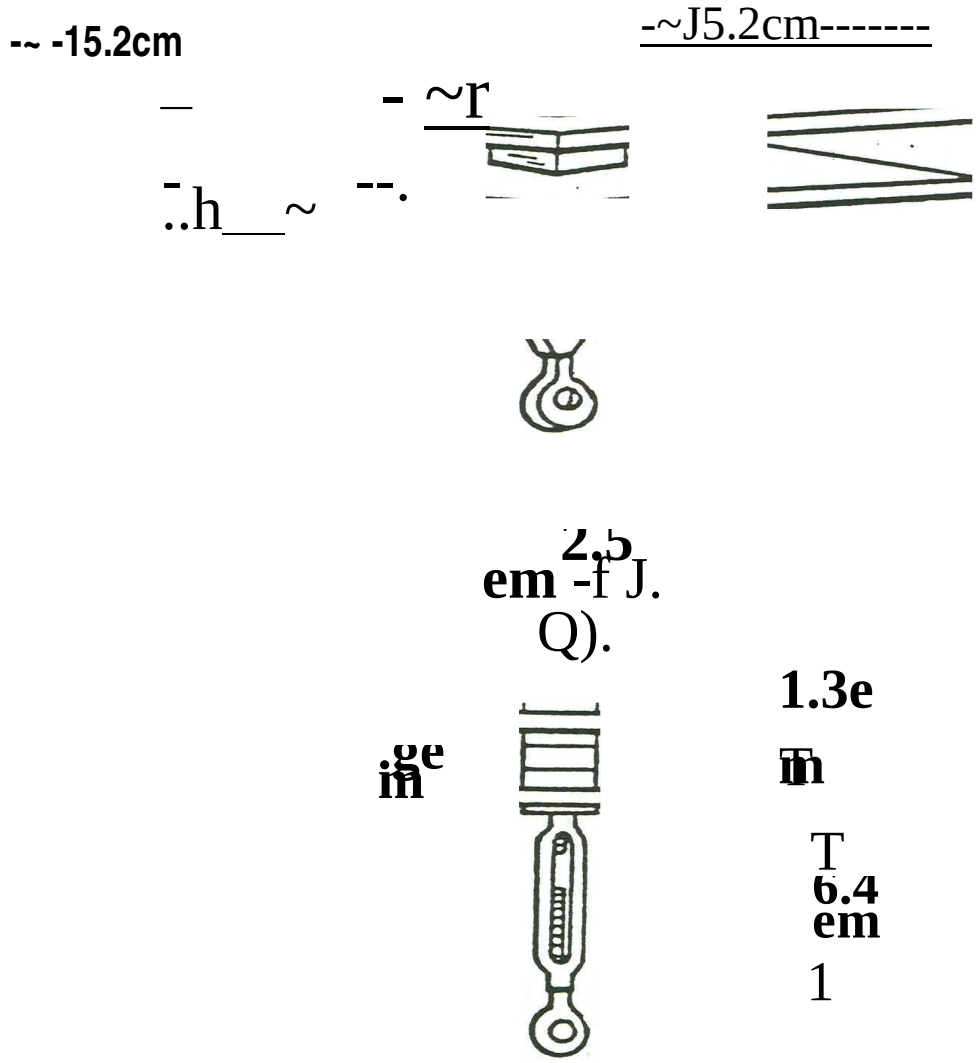
12.A. Multiplate Sampling

1. Rationale: Multiplates (multiple-plate samplers) are a type of artificial-substrate sampling device developed by Hester and Dendy. (1962). Artificial substrates collect a macro invertebrate sample by providing a substrate for macro invertebrate colonization for a fixed exposure period, after which the sampler is retrieved and the attached organisms are harvested. The use of artificial substrate samplers allows the comparison of results from different locations and times by providing uniformity of substrate type, depth, and exposure period. The multiplate macro invertebrate community is influenced more by water quality than by stream bottom conditions.

2. site selection: sites should have comparable current speed and canopy cover to both upstream and downstream sites to the degree possible. The specific sampling location is preferably a pool or run, rather than a riffle. Samplers should be placed in the main current, not in peripheral near-shore areas. In navigable waters, samplers should be placed at the edge of the actual navigation channel to avoid interference with boat traffic. If navigation buoys are available near the desired sampling site, these are usually chosen for the sampler location. sites are chosen which have a safe and convenient access.

3. Sampler construction: The sampler design is 3 square hardboard plates, separated by spacers, mounted on a turnbuckle (Figure 1.). Three square plates of tempered hardboard (smooth on both sides) are cut to the size of 6 inches (15 cm) on each side. A 1/4 inch hole is drilled through the center of each. Four square spacers of 1/8 inch tempered hardboard are cut to the size of 1 inch on each side. A 1/4 inch hole is drilled through the center of each. Three of the spacers are glued together to form a triple spacer, with the sides and holes aligned. The plates and spacers are mounted on a No. 13 aluminum turnbuckle as in Figure 1. The top plates are separated by the single spacer, and the bottom plates are separated by the triple spacer. A washer is placed above the top plate and below the bottom plate. Both the top and bottom eyebolts of the turnbuckle are tightened securely to prevent loosening during exposure. The total exposed surface area of the sampler is 0.14 square meters (1.55 square feet) .

Figure 1. MULTI PLATE **SAMPLER**

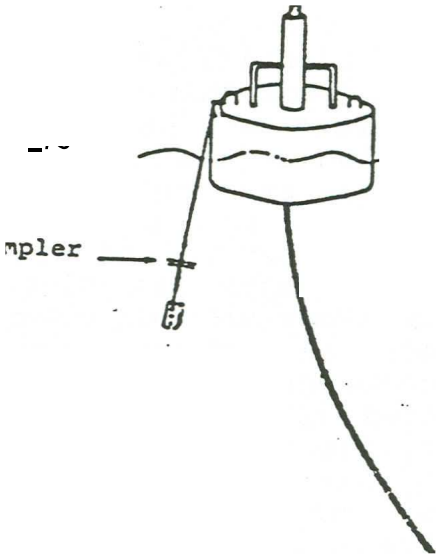


4. Sampler placement: Two sampling units are placed at each site during routine monitoring to increase the chances of recovering at least one sample in case of vandalism, washout, or mishandling during retrieval. The method of sampler placement is dependent on stream depth and buoy availability (Figure 2.). If navigation buoys are used, samplers are suspended with plastic-coated cable attached to a suitable above-water portion of the buoy. A plastic identification tag listing the agency is also attached with cable at this point. samplers are attached with brass swivel snaps to facilitate sampler retrieval and replacement. In waterways with stronger current, each sampler is stabilized with a brick weight attached to the bottom of the turnbuckle with a swivel snap. Samplers are installed 1.0 meters below the water surface. If navigation buoys are not available and stream depth is greater than 0.5 meters deep, the sampler is suspended from a float constructed of a two-liter plastic bottle filled with styrofoam chips. The float is anchored with a three-holed concrete block, 4 x 8 x 16 inches. Connections are made with 1/8 inch plastic-coated cable. Brass swivel snaps are used to connect the sampler to the cable. Samplers are installed 1 meter below the water surface; in streams 0.5-2.0 meters deep, the samplers are placed midway between the water surface and the stream bottom. In streams less than 0.5 meters deep, the sampler is attached directly to a concrete block. The type of block used is a patio block, 2 x 8 x 16 inches, with a center hole drilled for attaching the sampler turnbu0kle.

5. Sampler retrieval: Samplers are retrieved 5 weeks after placement. The sampler is carefully brought to the water surface and the swivel snaps are unhooked. The sampler is removed from the water and placed in a bucket of stream water. The sampler is disassembled using pliers and/or screwdrivers. All accumulated organisms and other material are scraped from the plates with a 3-inch wide paint scraper into the water in the bucket. The resultant slurry is poured into a u.S. no. 30 standard sieve, the residue rinsed with river water, and placed in a 4-ounce glass jar. 95% ethyl alcohol containing 125 mg/l rose bengal stain (Mason and Yevich, 1962) is added to fill the jar.

6. Sample sorting and subsampling: For routine monitoring, only one sample from each site/date collection is processed;
the other sample is retained for possible later use. The sample with the most accumulated material is selected for processing. The sample is rinsed with tap water in a u.S. no.
40 standard sieve to remove the rose bengal alcohol. The sample is examined under a dissecting stereomicroscope and the organisms are removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70% ethyl alcohol, and counted. For samples which are judged to contain more than 1000 individuals, one-half or

Figure 2.
- -,MUL TIPLATE SAMPLER INSTALLMENT



A. BUOY ATTACHMENT
FOR NAVIGABLE WATERS
WITH BUOYS

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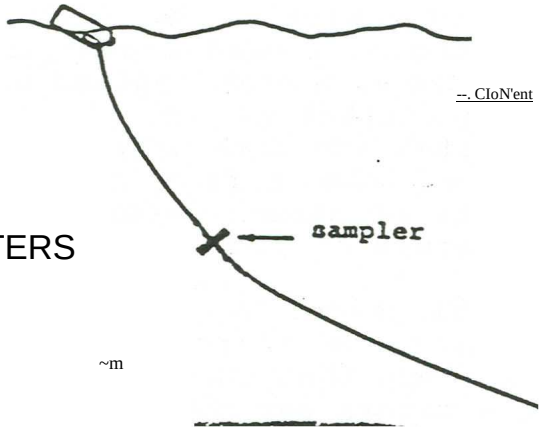
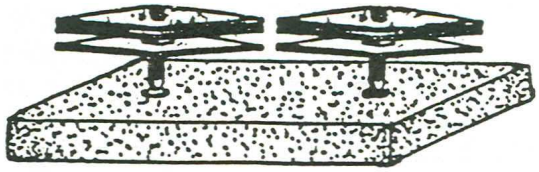



**B. FLOAT jBLOCK ATTACHMENT**
FOR NON-NAVIGABLE WATERS
> 0.5 METERS DEEP

**C. BLOCK ATTACHMENT** FOR
SHALLOW WATERS
<0.5 METERS DEEP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one-quarter subsamples may be examined. The subsampling is done by placing the sample ina tray, evenly distributing it over the bottom, and placing a divider in the tray which divides the sample into quarters. For samples with a large number of a particular group of organisms, the numeroUs group of organisms may be subsampled, while the remaining organisms are sorted from the entire sample. Sorted specimens of all samples are archived for possible future analysis.

7. Organism identification: Most organisms are identified to the species level when possible. Appendix IV lists the level of identification for major groups, including primary identification references. A complete species checklist for New York state streams and list of identification references is also included in Appendix IV. Chironomidae are subsampled for 100 individuals, and Oligochaeta are subsampled for 50 individuals. Both are cleared, 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 is recorded on. a Laboratory. Data Sheet (Appendix III). Rep~esentative specimens from a sample are selected and stored separately in a reference collection. The reference collection of identified specimens is maintained for comparative and quality control purposes.

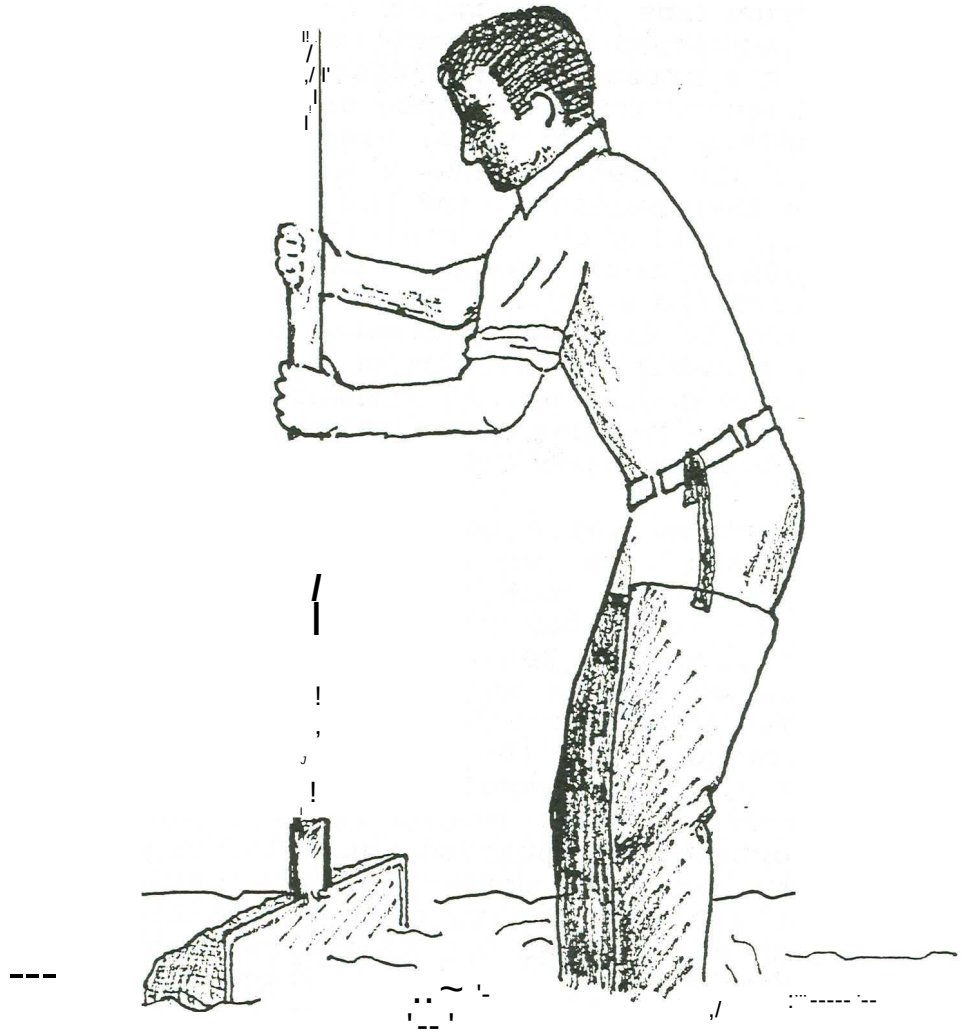
12.B. Kick sampling

1. Rationale: Kick sampling is a method of sampling benthic organisms by kicking or disturbing bottom sediments and catching the dislodged organisms downstream with an aquatic net. The use of a standardized traveling kick method provides a semi-quantitative sample of the resident benthic macro invertebrate community. The kick sampling technique and analysis of the riffle community lends itself to rapid assessments of stream water quality. Its use is limited to wadeable areas of flowing waters.

2. site selection: The sampling location should be a riffle with a substrate of rock, rubble, gravel, and sand. Depth should be less than one meter, and current speed should be at least 0.4 meters per second. The site should have comparable current speed, substrate type, and canopy cover to both upstream and downstream sites to the degree possible. sites are chosen to have a safe and convenient access.

3. Time of sampling: The preferred sampling time for kick sampling is July-September. Spring sampling is generally avoided due to high numbers of naidid worms frequently occurring in spring samples. In cases where samples are being taken to compare with previous samplings, the

Figure 3.
THE TRAVELING KICK SAMPLE



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

sampling time should concur with the previous time-of-year as much as possible. In such instances, spring sampling may be necessitated.

3. Sampling: An aquatic net (mesh opening size less than 0.9 square rom) is positioned in the water about 0.5 m downstream and the stream bottom is disturbed by foot, so that the dislodged organisms are carried into the net (Figure 3.). Sampling is continued for a specified time and for a specified distance in the stream. Rapid assessment sampling specifies sampling 5 minutes for a distance of 5 meters. The preferred line of sampling is a diagonal transect of the stream. The net contents are emptied into a pan of stream water. The contents are then examined, and the major groups of organisms are recorded, usually on the ordinal level (e.g., stoneflies, mayflies, caddisflies). Larger rocks, sticks, and plants may be removed from the sample if organisms are first removed from them. The net is thoroughly cleaned before further sampling by vigorous rinsing in the stream. The contents of the pan are poured into a u.S. no. 30 standard sieve and transferred to a quart jar. The sample is then preserved by adding 95% ethyl alcohol containing 125 mg/l rose bengal stain.

4. Sample sorting and subsampling: In the laboratory the sample is rinsed with tap water in a u.S. no. 40 standard sieve to remove the rose bengal alcohol. The sample is transferred to an enamel pan and distributed homogeneously over the bottom of the pan. A small amount of the sample is randomly removed with a spatula and placed in a petri dish containing 70% ethyl alcohol. This portion is examined under a stereomicroscope and the organisms are removed from the debris. As they are removed, they are sorted into major groups, placed in vials containing 70% ethyl alcohol, and counted. Sorting is continued until 100 organisms have been re~oved. The remaining portion of the sample is retained in alcohol, for possible future need of additional subsamples.
Determination of the need for additional subsampling is made following organism identification and preliminary analysis of the data. Situations which call for additional subsampling include those in which the results are ambiguous, suspected of being spurious, or do not yield a clear water quality assessment. When additional subsamples are taken, the indices are averaged with those of the existing subsample.

5. Organism identification: Procedures follow those for multiplate sampling with the exception of Chironomidae and Oligochaeta, which are identified in their entirety.

12. C. Tissue analysis sampling

1. Rationale: Macroinvertebrates are used as monitors of contaminants by collecting organisms and having their tissues analyzed. They are of particular interest because 1.) they bioconcentrate contaminants to levels several times that found in water, 2.) they occupy a middle position in the aquatic food chain, and may be linked to levels found in fish, 3.) they are less mobile and shorter lived than fish, and may be used to pinpoint a contaminant source in relation to time and location, and 4.) they are easily collected in most streams.

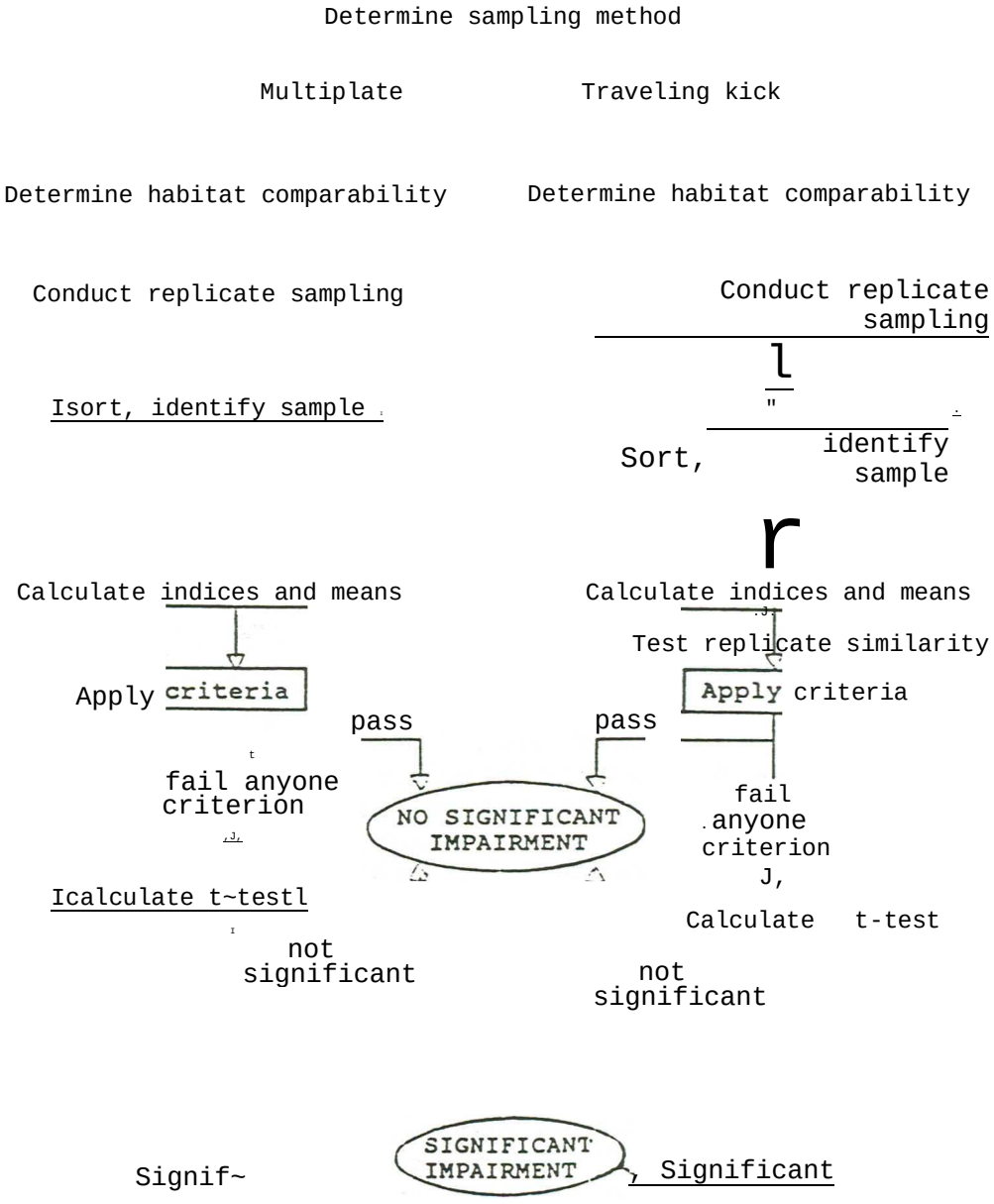
2. Field collection: For routine monitoring, it is desirable to collect the same type of organism at each site to allow maximum comparison of results. The organisms most commonly found in the majority of streams in adequate biomass for analysis are the net-spinning caddisflies (Trichoptera: Hydropsychidae) and crayfish (Crustacea: Decapoda). Caddisflies of the family Hydropsychidae are usually found attached to rocks in riffles or spillways. They are collected by removing rocks or other substrate items from the stream and hand-picking the specimens from the rocks with forceps. Crayfish are usually found under large rocks in streams; they may be collected by hand or net. The specimens are placed in Hexane-washed 8-ounce glass jars containing water from the stream being sampled. The jars are kept on icJ in a cooler until returned to the laboratory. If caddis flies or crayfish are not available at a site, alternate organisms may be collected for tissue analysis. Organisms are selected primarily on the basis of available numbers and size for attaining adequate biomass for analysis.

3. Laboratory sorting: In the laboratory the contents of the jar are emptied into a washed petri dish and examined under a dissecting stereomicroscope. The specimens are identified to genus or species; larger foreign particles are removed from the organisms. The organisms are placed in scintillation vials (without water) or 8-ounce glass jars and stored in a freezer until preparation for analysis. Prior to submitting specimens for analysis, they are weighed (wet-weight), freezedried, and re-weighed (dry-weight).

12. D. Impact Assessment Compliance Sampling

1. Background/rationale: Biological impairment criteria for flowing waters in New York State were recently introduced into the biological monitoring program (Bode et al., 1990). These criteria allow determination of significant water quality impairment based on upstream/downstream changes in one of five biological indices. The criteria are used for enforcement or compliance monitoring, as distinguished from trend monitoring. An outline of procedures is provided below and in Figure 4.

Figure 4. Biological Impairment Criteria Flow Chart



The Biological Impairment criteria document (Bode et al., 1990) should be consulted for a detailed description.

2. Sampling: Determine appropriate sampling method by measuring habitat parameters at available upstream and downstream sites. Kick sampling is used for wadeable riffles with rock/gravel/sand substrates; multiplate sampling is used for all other habitats. Select an upstream site and a downstream site that meet the habitat criteria for site comparability. Conduct sampling at the upstream and downstream site. For kick sampling, four replicates are collected at each site. For multiplate sampling, 3 5-week exposures are conducted.

3. sample sorting and identification: Kick samples are sorted for 100 individuals as described in section 12.B.4. Multiplate samples are sorted as described in section 12.A.6. Identification procedures for both follow those described in section 12.A.7. For kick samples, use percentage similarity to calculate similarity between three of the replicates at each site. If similarity is less than 50 for any replicate pairing, re-subsample 100 organisms from the replicate with the lowest average similarity. If similarity is still less than 50 for the replicate pairing, subsample a fourth replicate from the site. If 50% similarity cannot be achieved with these replicates or subsamples, re-sampling is necessary.

4. Data reduction: Calculate the parameters from each sample, parameters a-e for kick samples and parameters a-d for multiplate samples. Compute the average index value for the 3 samples from each site for each index:

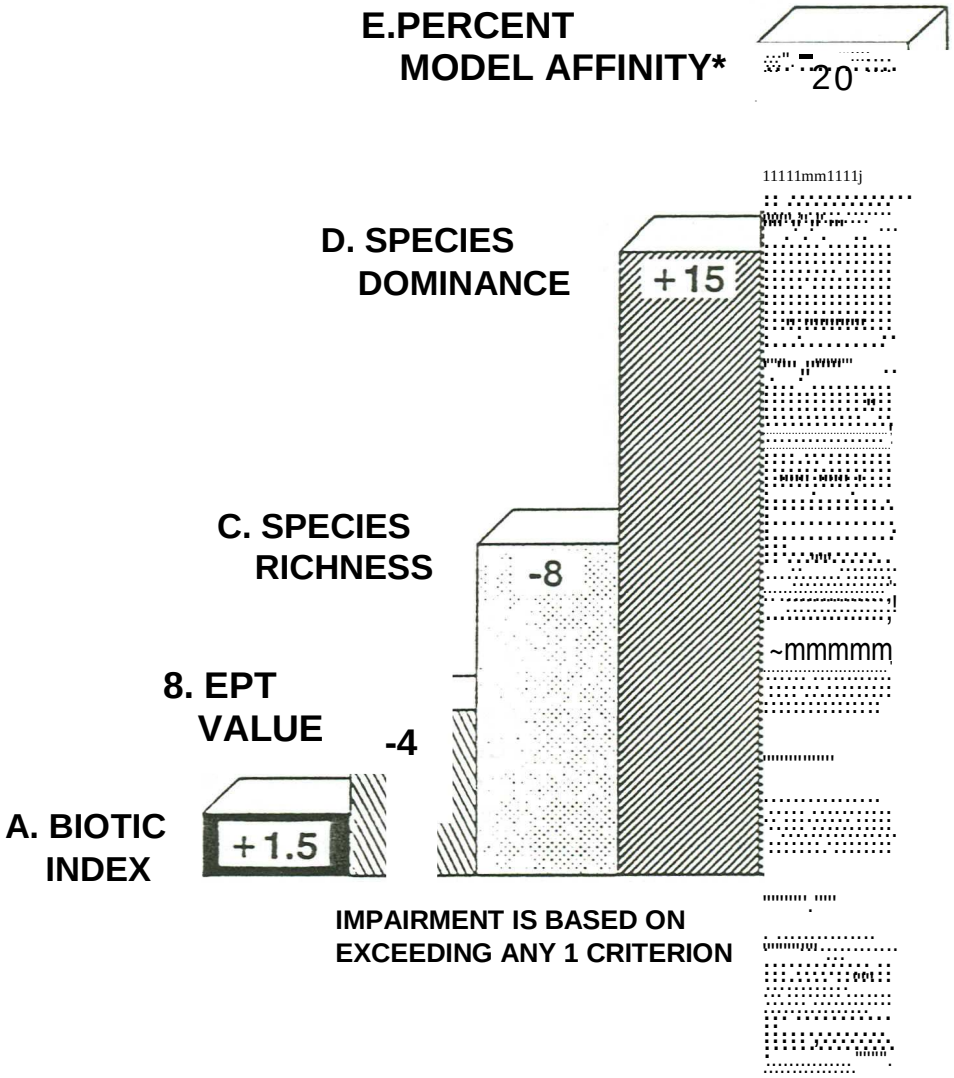
a. Biotic index
b. EPT value
c. Species richness
d. Species dominance
e. Percent model affinity

5. Determination of impairment: Compare values from the downstream site to those from upstream site. For kick samples, violation of 1 or more of the criteria for parameters a-e indicates provisional impairment (Figure 5). For multiplate samples, violation of 1 or more criteria for parameters a-d indicates provisional impairment.

a. Biotic index: +1.5 (0-10 scale) b.
EPT value: -4
c. Species richness: -8
d. Species dominance: +15
e. Percent model affinity: -20

For sites with provisional impairment, perform the Student's T-test to determine if results are statisticallY5ignificant at the level P=.05. If results are significant, biological impairment is indicated.

Figure 5.
BIOLOGICAL IMPAIRMENT CRITERIA FOR FLOWING WATERS IN NEW YORK STATE



12. E. Measurement of physical/chemical parameters

1. Dissolved oxygen: measured with a Yellow Springs Instruments Model 54 oxygen meter. Measurement is made in situ one meter below water surface, or may be taken from fresh grab sample at site. Profile sampling is performed if warranted.

2.. pH: measured with an Orion model 399 A/F pH meter. Measurement is made from fresh grab sample at site.

3. Conductivity: measured with a Yellow Springs Instruments Model 33 S-C-T meter. Measurement is made in situ one meter below water surface, or may be taken from fresh grab sample at site. Profile sampling is performed if warranted.

4. Temperature: measured with a Yellow Springs Instruments Model 33 S-C-T meter. Measurement is made in situ one meter below water surface, or may be taken from fresh grab sample at site. Profile sampling is performed if warranted.

5. Current speed: surface current speed is measured by timing floating objects over a fixed distance. Portions of wooden tongue depressors are timed over a distance of 5 meters, and converted to centimeters per second. Alternately, floating debris may be measured over a distance of C'ne meter and converted to centimeters per second. Timing is done with a digital watch accurate to 0.1 second.

6. Substrate type: substrate types are selected from EPA size categories listed below. categories are noted in estimated order of dominance.

Type	Size or characteristic
Bed rock	or solid rock
Boulders	greater than 256 rom (10 in.) in diameter
Rubble	64-256 rom (2 '1/2 - 10 in.) in diameter
Gravel	2-64 rom (1/2 - 2 1/2 in.) in diameter
Sand	0.06-2.0 rom in diameter; gritty texture
silt	0.004-0.06 rom in diameter
Clay	less than 0.004 rom in diameter

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13. Sample Custody Procedures

13. A. Macroinvertebrate community assessment samples

1. Sample jars are labelled with adhesive labels on jar and lid.

2.. General contents of sample are noted in field for major groups of organisms present and approximate amount of biomass. These are recorded on field data sheet.

3. Samples are transported to laboratory in sample jar boxes. Samples are stored in laboratory until analyzed.

4. When sorting and identification are complete for a sample, the results are validated by comparing to field notes describing sample.

13. B. Macroinvertebrate tissue analysis samples

1. Samples jars are hexane-washed in laboratory. labelledJars are with adhesive label and tie-tag.

2. Organisms are removed from substrate and pla~ed in jar with forceps.

3. Samples are placed on ice and transported to the laboratory.

4. After transfer to laboratory, samples are immediately sorted and prepared for freeze-drying. Sample information is recorded in laboratory record book.

5. Samples to be retained for later analysis are stored in laboratory freezer.

6. Just prior to analysis samples are hand-delivered to proper laboratory.

7. If the intended use of the data generated by the sampling is compliance- or enforcement-related, Chain Of Custody forms (Appendix II) are used and signed with each sample transfer.

14. Calibration Procedures and Preventive Maintenance

14. A. Dissolved oxygen meter: air calibrated prior to each sampling with elevation air pressure and ambient air temperature. The meter is inspected and cleaned at least once yearly. New batteries are installed yearly or as needed.

14. B. pH meter: standardized daily or as needed with pH 7 and pH 9 buffers. Batteries are charged monthly or as needed. The meter is inspected and cleaned yearly, and new buffers are obtained yearly. The probe tip is cleaned by soaking in 1 molar hydrochloric acid for 2 hours, once yearly or as needed.

14. C. SCT meter (salinity, conductivity, temperature) : standardized yearly with standard solution. Temperature readings are checked monthly with hand-held thermometer. The meter is inspected and cleaned yearly. New batteries are installed yearly or as needed.

15. Documentation. Data Reduction. and Reporting

Resuits from tissue analysis samples are compared to provisional contaminant guidelines developed for caddisflies and crayfish (Appendix II). Values exceeding these guidelines are appropriately reported. Results from community assessment samples are treated using the following steps:

15. . A. Raw data (species identifications and number of individuals of each species) are recorded on a separate laboratory data sheet for each site/date collection. Laboratory data sheets are stored in a laboratory notebook.

15. B. Data from laboratory data sheets are entered on computer storage using the Lotus program. This information includes waterbody, station, collection date, species, number of individuals, and collection method.

15. C. Lotus files of data are translated to a dBase file for permanent storage and further analysis of the data. Functions performed by a dBase program include calculation of species richness, EPT, biotic index, diversity, percent model affinity (PMA), percent contribution of seven major groups, and five most abundant species and their percent contribution (Appendix I). These index values are stored in a separate dBase file.

15. D. The overall assessment of water quality baued on the four indices is accomplished through the "0' Brien Plot", a scaled ranking of the index values. Conversion formulae transform index values onto a common scale of water quality ranging from 0-10, with 0 being poor water quality (severely impacted) and 10 being excellent water quality (non-impacted). The conversion formulae are based on the expected range for each index within each category of impact (see Appendix I). Scaled values can alternatively be read directly from the scale. After. all index values are converted to a common scale value, these are averaged to obtain a score denoting overall assessment of water quality into one of the four categories of impact.

15. E. Data are summarized on a "Laboratory Data Summar.f Sheet" (see Appendix III) by means of a dBase printing program. This sheet includes site information, species richness, EPT value, biotic index, diversity or Percent model affinity, percent contribution of seven major groups, and five most abundant species, their common name, tolerance, and percent contribution, and water quality assessment.

15. F. Reports of results include the following elements: background of study (including reasons for surveying), results and conclusions, descriptions of sites sampled, discussion of biological results, comparison to previous studies, summaries of field and laboratory data, and literature cited.

16. Data Validation

Data validation procedures are outlined for the major program elements:

16. A. Organism identification: internal checks are frequently conducted among primary and secondary identifiers to assure internal consistency. Frequent comparison of voucher specimens is made .with laboratory reference collection. All species identifications are verified on the New York. state speci~s checklist, the U.S. EPA regional checklist, and the known distribution of the species as given in the primary reference.

16. B. Multiplate samples: multiplate samples are compared with same site samples from other months to determine if the sample may be invalidated by disturbance during the exposure period. Samples which show a 50% reduction in species from other months (same year) will be invalidated unless confirmed by replicate sampling.

16. C. Kick samples: kick sample results are compared to field records of observed organisms to determine if the kick sample is representative of the fauna in the area sampled. Samples which show less than 50% of the major groups observed in the field will be invalidated unless confirmed by replicate sampling or additional subsampling.

16. D. Subsamples: frequent internal checks of subsamples are conducted to assure validity of subsampling procedures . Split sample subsamples which show less than 75% similarity (percentage similarity) are considered invalid, and replicate subsampling must be completed.

16. E. Data entry validation and transmittal errors: All data entered onto computer files is validated by comparison of number of individuals and number of species from each Laboratory Data Sheet. Frequent spot checks are also made of individual entries.

17. Performance and System Audits

In addition to frequent internal audits, the laboratory has participated in external performance evaluation studies by the U. S. EPA. Identification of a macro invertebrate test sample was evaluated by the U.S. EPA. The laboratory has also been evaluated by on-site visits and observation of field techniques by the U.S. EPA.

18. Corrective Action

Corrective action procedures are outlined for the major program elements:

18. A. organism identification: species identifications which are not found on the New York state species list or the U. s. EPA regional species checklist, and which are outside of the known distribution of the species as given in the primary reference must be verified by consultation with regional biologists or the appropriate taxonomic authority. Internal taxonomic discrepancies are corrected by auditing previous identifications of the species in question and making necessary changes to insure consistency. All species name changes are appended to the species list.

18. B. Multiplate samples: samples which are shown to be invalid are not included in the data analysis process.

18. C. Kick samples: samples which are shown to be invalid and cannot be resolved by additional subsampling are not included in the data analysis process.

18. D. Subsamples: repl icate sampl ing must be conducted for subsamples shown to be invalid. Subsampling procedures which repeatedly yield invalid subsamples must be re-evaluated and appropriately modified.

18. E. Data entry validation and transmittal errors: all computer-entered data which is not verified by number of individuals and number of species from the Laboratory Data Sheet is considered invalid until corrections have been made. Errors found in spot checks of individual entries must be corrected, and additional spot checks conducted.

19. Reports

19. A. Monthly reports are issued to inform appropriate management personnel of progress in the execution of the work plan. The reports include major accomplishments or findings, significant meetings or workshops attended, training courses completed, and outstanding problems.

19. B. Water quality reports are issued upon completion of a major program element, (e.g., stream survey, or completion of a RIBS cycle). These reports are prepared as outlined in section 15.

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Appendix I. MACRO INVERTEBRATE COMMUNITY PARAMETERS

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

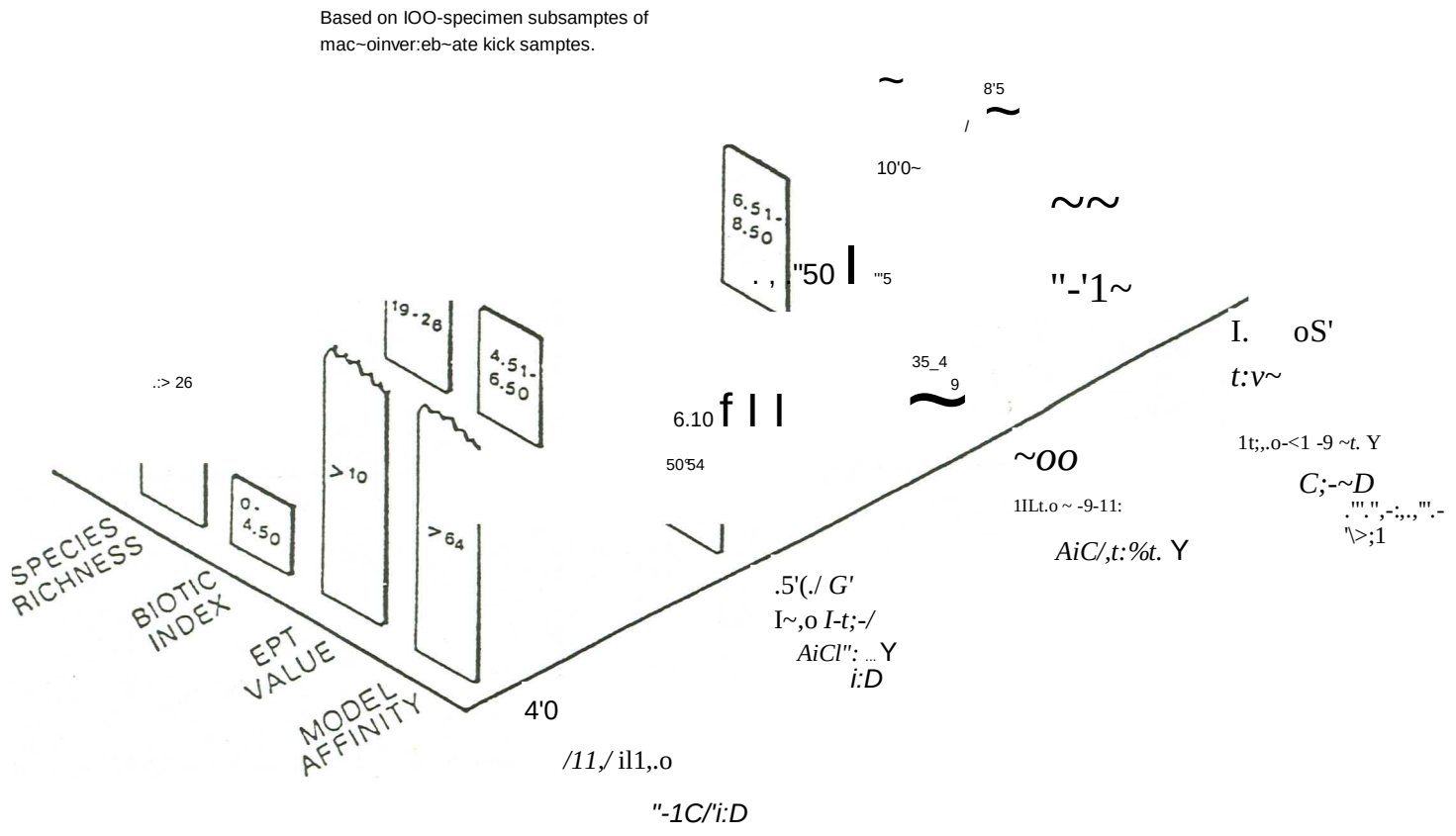
2. EPT value. EPT denotes the total nuInber of species of mayflies (EPhemeroptera), stoneflies (Plecoptera),. and caddisflies (Trichoptera) found in an average 100organism subsample. These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality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

3. Biotic index. The Hilsenhoff Biotic Index is calculated by multiplying the number of individuals of each species by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). Tolerance values, listed in Appendix IV, are mostly from Hilsenhoff (1987). Ranges for the levels of impact are: 0-4:50, nonimpacted; 4.51-6.50, slightly impacted; 6.51-8.50, moderately impacted; and 8.51-10.00, severely impacted.

4. Percent Model Affinity is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, in prep). Percentage similarity as calculated in Washington (1984) is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

5. Species diversity is a value which combines species richness and community balance (evenness). Shannon-Wiener diversity values are calculated using the formula in Weber (1973). Expected ranges for most New York State streams are: >3.99, non-impacted; 3.00-3.99, slightly impacted; 2.00-2.99, moderately impacted; and <2.00, severely impacted. Species diversity is used for multiplate samples in place of percent model affinity.

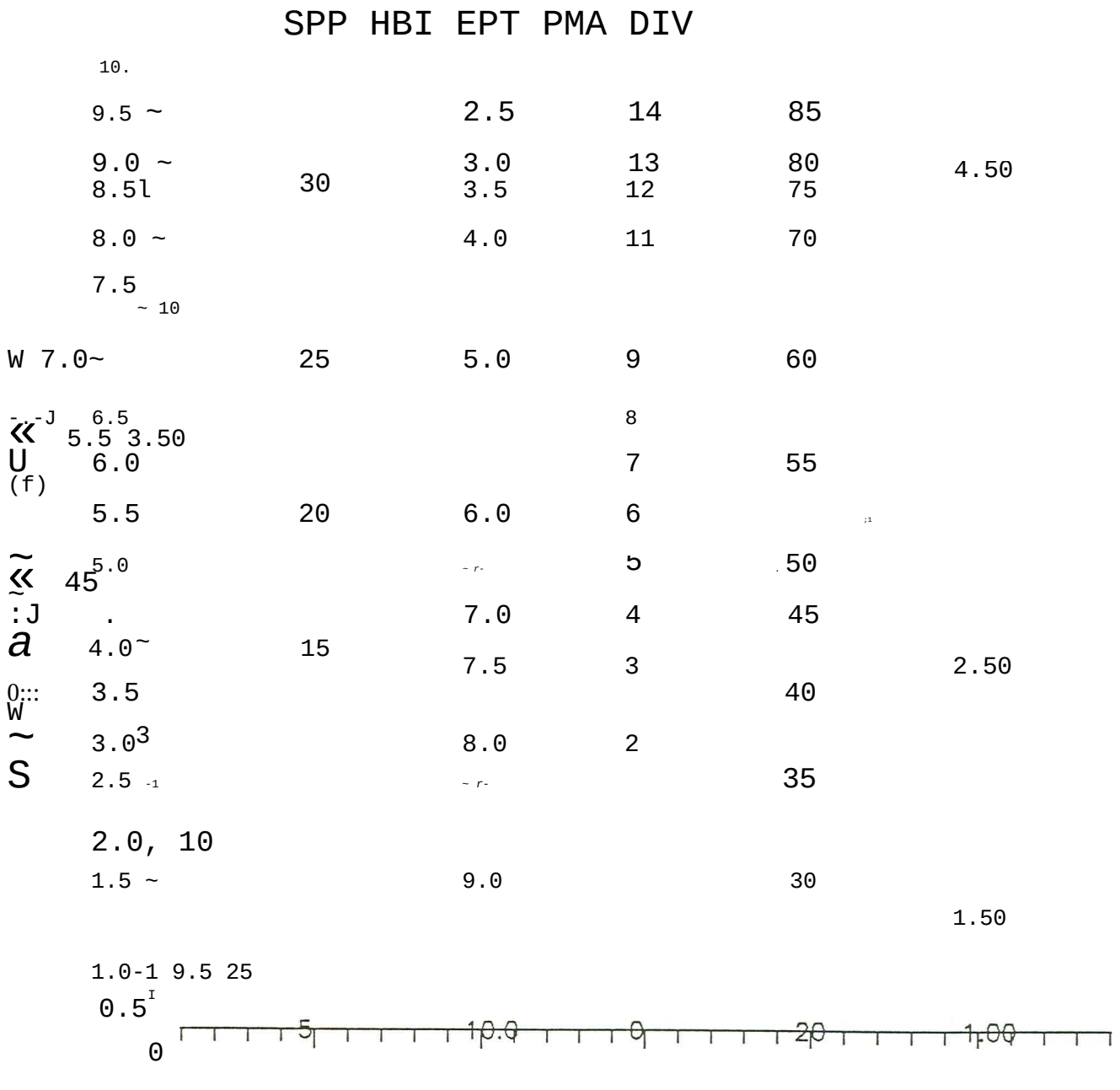
Detection criteria used to determine level of water quality impact in trend monitoring.



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

THE "O'BRIEN PLOT" OF INDEX VALUES

The O'Brien Plot of index values, developed by Phil O'Brien, P.E., Division of Water, NYS DEC, is a method of plotting biological index values on a common scale of water quality impact. The four indices and expected ranges in each category of water quality are shown in the figure below.



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

Appendix I (cont.) PROCEDURE FOR CALCULATING THE HILSENHOFF BIOTIC INDEX.

1. Determine the tolerance value for each species in the sample. Each value is an assigned number from 0-10 bas~d on its tolerance, 0 being very intolerant and 10 being very tolerant. These are available in the New York state species list (Appendix IV) or in Hilsenhoff (1987).

2. For each species, multiply the number of individuals by its tolerance value. Total all these products.

3. Divide the total of tolerance value/individuals products by the total number of individuals in the sample. This is the biotic index value.

Example:

Genus/ species	indo	tol.	tol. sub.
OLIGOCHAETA			
Nais communis Pristina leidyi	5 3	8	40
MOLLUSCA			
Phvsa qvrina	2	8	24
EPHEMEROPTERA			
Baetis amplus Stenonema ithaca Drunella cornuta	10 3 1	8 6	16 60
PLECOPTERA			
Paraqnetina media	1	3	9
COLEOPTERA		0	0
Stenelmis crenata	9	1	1
TRICHOPTERA			
Cheumatopsyche sp.	19	5	45
Hvdropsvche morosa	15	5	95
Hvdroptila sp.	2	6	90
CHIRONOMIDAE			
Conchapelopia sp.	3	6	12
Cricotopus bicinctus	1	6	18
Orthocladius sp.	2	7	7
Polvpedilum sp.	24	6	12
		6	144
TOTAL	100		573

HBI= 5.73 (tolerance subtotal divided by 100 individuals)

ind: number of individuals. tol: assigned tolerance value. tol. sub.: subtotal of tolerance value x number of individuals.

Appendix I (cont.) PROCEDURE FOR CALCULATING PERCENT MODEL AFFINITY

1. Determine the percent contribution for each of the 7 major groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera,Chironomidae, and Other. These must add up to 100.

2. For each group find the absolute difference in percentage from the model value for that group. Add up these differences.

3. Multiply the total of differences by 0.5 and subtract this number from 100. This is the Percent Model Affinity.

Example:

	Sample	Model	Absolute difference
OLIGOCHAETA	8	5	3
EPHEMEROPTERA	14	40	26
PLECOPTERA	1	5	4
COLEOPTERA	9	10	1
TRICHOPTERA	36	10	26
CHIRONOMIDAE	30	20	10
OTHER	2	10	8
TOTAL	100	100	78

TOTAL ABSOLUTE DIFFERENCE= 78

78 x 0.5= 39

100- 39= 61= PMA value

Appendix II. PRIORITY POLLUTANTS IN MACROINVERTEBRATES: METALS

Concentrations considered provisionally to exceed background levels in tissues of selected macroinvertebrates. All concentrations in mcg/g (ppm) dry weight.

contaminant	Caddisflies	Crayfish
ALUMINUM	5000	400
ANTIMONY	75	20
ARSENIC	4	3
BARIUM	300	300
BERYLLIUM	2	.4
CADMIUM	10	2
CHROMIUM	20	7
COBALT	10	2
COPPER	40	200
IRON	7000	700
LEAD	20	20
MANGANESE	4000	1000
MERCURY	5	.2
MOLYBDENUM	30	10
NICKEL	10	3
SELENIUM	2	1
SILVER	15	4
STRONTIUM	75	1000
THALLIUM	40	20
TIN	75	20
TITANIUM	100	8
VANADIUM	10	2
ZINC	250	200

Most background levels were determined by frequency distributions of state-wide sampling, including 33 caddis fly samples and 16 crayfish samples. This sampling represented a wide range of water quality from non-impacted to severely impacted. Provisional background levels were set at the level of the mean plus 2.57 standard deviations from the mean. Results reported as below detectable levels were entered as the detection limit, for purposes of the frequency distribution. Provisional levels were sometimes adjusted to reflect known problems. Background levels for metals which were not found above detectable levels were determined by using levels of detection and available data from the literature.

Appendix II, cont. PRIORITY POLLUTANTS IN MACROINVERTEBRATES: PCBs

Concentrations considered to exceed guidelines, based on correlations with PCB levels in fish.

	Macroinvertebrates	Fish
FEDERAL HUMAN HEALTH STANDARD	0.2 ppm* wet wt. 1.0 ppm dry wt.	2 ppm
NYS WILDLIFE PROTECTION STANDARD	0.01 ppm* wet wt. 0.05 ppm dry wt.	0.1 ppm

*The level for caddisflies is derived from the level for fish,. based on the working ratio.

DERIVATION OF GUIDELINES

	Caddisflies	Fish
WORKING RATIO	1	9 (+ 6.5)

The working ratio of 1 to 9 (95% confidence level) for PCBs was derived by Novak (1987), based on correlations of PCB levels in macro invertebrates and fish. This means that if macro invertebrates are found to contain 1 ppm PCBs wet weight, fish samples from the same location and year are expected to contain 2.5 to 15.5 ppmPCBs in 95% of the tases. This is considered a working model that should be tested further with additional correlations of PCB data from fish and macroinvertebrates.

Novak, M.A. 1987. The correlation of macro invertebrate and fish PCB levels in New York State. NYS DEC Technical Memorandum, 10 pages.

Appendix III. Forms.

The following sample forms are attached:

1. Survey Request Form: to be completed by the requestor of the survey prior to any sampling or reconnaissance work.

2". Field Data Sheet: to be completed by the collector at the time of sampling.

3. Laboratory Data Sheet:. to be completed by laboratory personnel at the time of organism sorting and identifying.

4. Field Data Summary Sheet: to be completed by the reporter at the time of report preparation, summarizing information from Field Data Sheets. This form may also be used directly at the time of sampling, in place of Field Data Sheets.

5. Laboratory Data Summary Sheet: to be completed by the reporter at the time of report preparation, summarizing information from Laboratory Data Sheets and subsequent calculations.

6. Chain Of Custody: to be completed with each sample transfer for data to be used in compliance- or enforcement-related matters.

SURVEY REQUEST FORM

New V-" State o.,.nmentof
1IMr.._~ c: -.....

Stream name County

Reach included

Backgro~nd - Describe reason(s) for concern (fishkills, complaints, etc.)

Attach sketch *of* stream showing landmarks (bridges, adjacent roads, tributaries, buildings, etc.) and approximate location(s) *of* point discharges and non-point problem areas.

Description of point discharges

Facility name	Location of discharg~:.	Type.of discharge	Known or suspected problem parameters (D.O., solids, taxies. etc. -.be specific)

Non-point problems

Type of problem	Area involved	Known or suspected problem parameters

Completed by Date

Field contact Name Telephone ( )

Affiliation

FIELD DATA SHEET

New.Vorit Sute Department
of Environmental
Conservation

STREAM\STATION
DATE.
TIME: ARRIVAL
DEPARTURE
COLLECTORS

SITE ACCESS:
TOWN\ROUTE NO.

LANDMARKS (exact location)

PHYSICAL AND CHEMICAL PARAMETERS

- DEPTH (meters)

WIDTH (meters)
CURRENT (em per sec.)

CANOPY (%)

EMBEDDEDNESS (%)
SUBSTRATE (%) rock rubble gravel sand silt

TEMPERATURE (0 C)

CONDUCTIVITY (pmhos) DO

(mg per Ii ppm)

pH

OTHER

AQ. VEGETATION algae (suspended) algae (filamentous)
diatoms (on rocks) - macrophytes ~

TYPE OF SAMPLE

multiplate kick
ponar organisms
for photograph
other toxics

OCCURRENCE OF MACROINVERTEBRATES

Chironomidae
Trichoptera
Ephemeroptera
Plecoptera
Coleoptera
Oligochaeta
Other

FIELD ASSESSMENT OF IMPACT: non slight -- moderate severe

absence of E P T taxa --- dominance of tolerant groups
abundance (low\high) --- richness (low\high)

NOTES, OBSERVATIONS, MAPS

. .. .: {, .;;'...' ';"" .j} .':,..:~ ~";-:1",.': ~>: ;-.. a,,;,.,..:.:,:.t..,i~":,:.c'q~; :1';:::,j [,~;'w;,,'";;(~~~t';.,;:~ -1.<':a~i1." «':::,,,.'(W:~,,1;;,,,,:,,;:.;..~~ ;ibi~;~~,';f/';~'~"""{~I'~"I'~"if~::""~~;'";~d'~,';oj;.:r:;;(~~~':

lABORATORY DATA SHEET

New yon. Sr.'e
Department of
Environment.' Cona_cIon

Individuals	River/stream
Taxa.	Staton Ilumoer
Subsample: entire 1/2 1/4 100	Date
Sorted by:	S_amp). :typ

	est. biomass	subsample t.otal		subsa..ple t.ot.al
PLATYHELMINTHES			COLEOPTERA	
			1.	
OLIGOCHAETA			2.	
1.			3.	
2.			4.	
3.			5.	
4.			TRICHOPTERA	
5.			1.	
6.			2.	
7.			3.	
8.			4.	
9.			5.	
10.			6.	
HIRUDINEA			7.	
			8.	
MOLLUSCA			9.	
1.			10.	
2.			OTHER DIPTERA	
3.			1.	
4.			2.	
5.			3.	
CRUSTACEA			4.	
			5.	
ACARI FORHES			CHIRONOMIDAE larvae	
			pupae	
MEGALOPTERA			total	
			1.	
EPHEHEROPTERA			2.	
1.			3.	
2.			4.	
3.			5.	
4.			6.	
5.			7.	
6.			8.	
7.			9.	
8.			10.	
9.			11.	
10.			12.	
11.			13.	
12.			14.	
PLECOPTERA			15.	
			16.	
			17.	
OTHER INSECTA			18.	

FIELD DATA SUMMARY SHEET

STREAM NAME: Owasco Outlet
REACH: Auburn to below Port Byron DATE SAMPLED: 07-17-90
FIELD PERSONNEL INVOLVED: Abele, Bode

STATION	02 03 05			06 10:45
AREIVAL TIME AT STATION	9:00 9:35 10:15			Auburn PD
LOCATION	Auburn, Auburn below STP Auburn		Canoga st	frg.range
PHYSICAL CHARACTERISTICS width (meters)	25	10	20	20
Depth (meters)	0.2	0.2	0.2	0.2
Current speed (cm per sec)	50	100	77	100
Substrate (%)				
rock (> 10 in.)	20	20	30	20
rubble (2.5-10 in.) gravel	40	50	40	40
(0.08-2.5 in.) sand (0.06-2.0	30	20	20	30
rom)	10	10	10	10
silt (0.004-0.06 rom) clay	0	0	0	0
(less than 0.004 mm)	0	0	0	0
Embeddedness (%)		50	50	50
CHEMICAL MEASUREMENTS				
Temperature (oC) Conductivity	20.5	20.0	19.5	19.5
(umhos) Dissolved Oxygen (mg per	310 8.4	390	390	360 7.7
1) pH - Other		6.8	6.6	
BIOLOGICAL ATTRIBUTES				
Canopy (%)	10	10	10	40
Aquatic Vegetation algae -				
water column algae -				
filamentous algae -		present		
diatoms macrophytes			present	present
~ccurrence of Macroinvertebrates				
Chironomidae (midges) Trichoptera	X	X	X	X
(caddisflies) Ephemeroptera	X	X	X	X
(mayflies) Plecoptera (stoneflies)	X			
Coleoptera (beetles) Oligochaeta				
(worms)	X			X
Other		X		
	X	X	X	X
ESTIMATED BIOMASS	low	medium	medium	medium
FIELD ESTIMATE OF WATER QUALITY	sIt	mod	mod	mod
FIELD COMMENTS	poss.lake effect community	chlorine effects?	recovery	recovery

LABORATORY DATA SUMMARY

STREAM NAME Owasco Outlet
DRAINAGE 07
DATE SAMPLED 07/17/90
COUNTY Cayuga
SAMPLING METHOD Traveling kick

STATION	02	03	05	06
LOCATION	Auburn above STP	Auburn below STP	below Auburn	Auburn PO frg. range

DOMINANT SPECIES\% CONTRIB~TION\TOLERANCE\COMMON NAME

Genus and species names are abbreviated here to accommodate format. Complete names are reported elsewhere. For description of tolerance, intolerant = not tolerant of poor water quality; facultative = occur over a wide range of water quality; tolerant = tolerant of poor water quality.

	02	03	05	06
1.	I Tvetenia vitracie 18 facultative midge	Nais bretsch 38 facultative worm	Caecidotea sp.20 tolerant sowbug	Hydropsyche sparna 49 facultative caddisfly
2.	INais bretsch 17 facultative worm	Nais variab 14 tolerant worm	Polypedilum convict 19 facultative midge	Thien'myia gr. spp. 9 facultative midge
3.	I Hydropsyche sparna 15 facultative caddisfly	Cricotopus bicinct 11 facultative midge	Polypedilum illinoe 16 facultative midge	Polypedilum convict 8 facultative midge
4.	IRheotany exiguus 8 facultative midge	Orthoclad dent 9 facultative midge	Hydropsyche sparna 10 facultative caddis fly	Stenelmis sp. 8 facultative beetle
5.	IUndeterm. Turbell 5 facultative flatworm	Polypedilum illinoe 6 facultative midge	Cricotopus bicinct 10 facultative midge	Tanytarsus glabresc 6 facultative midge

% CONTRIBUTION OF MAJOR GROUPS (NUMBER OF TAXA IN PARENTHESES)				
Chironomidae (midges)	39 (9)	34 (6)	(6)	32 (10)
Trichoptera (caddisflies)	18 (3)	2 (1)	12 (3)	50 (2)
Ephemeroptera (mayflies)	1 (1)	0 (0)	1 (1)	0 (0)
Plecoptera (stoneflies)	0 (0)	0 (0)	0 (0)	0 (0)
Coleoptera (beetles)	6 (2)	0 (0)	0 (0)	8 (2)
Oligochaeta (worms)	23 (1)	0 (0)	0 (0)	4 (1)
Others (**)	13 (5)	2 (1)	9 (3)	6 (2)
TOTAL	100	62 (6)	24 (6)	100 (19)
SPECIES RICHNESS	23	14	17	19
RBI INDEX	6.00 (23)	7.12 (14)	6.49 (17)	6.06 (19)
EPT VALUE	4	1	4	2
PMA VALUE	52	29	46	48
FIELD ASSESSMENT	slight	moderate	moderate	moderate
OVERALL ASSESSMENT	slightly impacted	moderately impacted	moderately impacted	moderately impacted

** damselflies,scuds,crayfish,leeches,sowbugs,blackflies,hellgrammites, snails,dragonflies

82.14-&4 *(7/BS)*

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION'

CHAIN OF CUSTODY

I, (Print N.mel ı of (Print AOOreu) have colletted the 'on 198- from in the vicinity of Town of County.

Items:

said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Depart ment of Environmental Conservation on , 198_.

Signature Date

I, , have received the above mentioned samples on the date specified and have assigned identification number(s) to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and dates as attested to below.

Signature Date

SECOND RECIPENT (Print Name)	TIME AND DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPENT (Print Name)	TIME AND DATE	PRUPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPENT (Print Name)	TIME AND DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME AND DATE	•
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME AND DATE	ACCESSION NUMBERS:
SIGNATURE	UNIT	

Appendix IV. Level *of* taxonomy and taxonomic keys required for macro invertebrate identification. Numbers correspond to references listed in Appendix V.

Phvloqenetic qroup! taxonomic level	Identification reference no.
Coelenterata: family Nemertea:	54
genus Platy~elminthes: class	54
Polychaeta: genus Oligochaeta	54
Lumbricina: order	54
Lumbriculidae: genus	
Enchytraeidae: family	87
Tubificidae: species	12 or 87
Naididae: species	12 or 87
Hirudinea: order Aphanoneura:	12 or 87
family Branchiobdellida: order	12 or 87
Gastropoda	43, 54, or 87 54
Physidae: species	or 87
Lymnaeidae: species	54
Planorbidae: species	
Ancylidae: species	35 or 87
Viviparidae: species	35 or 87
Pleuroceridae: species	35 or 87
Hydrobiidae: species	35 or 87
Valvatidae: species	35 or 87
Pelecypoda	35 or 87
Unionidae: species	35 or 87 '
Sphaeriidae: genus	35 or 87
Crustacea	
Anthuridae: family	21 or 87 87
Idoteidae: family	
Asellidae: genus	
Gammaridae: genus	114
Oedicerotidae: family	114
Talitridae: family	54 or 87 54 or
Cumacea: order	87 114
Decapoda: order	54 or 87 114
Arachnoidea: order Collembola:	54 or 87 54 or
order Ephemeroptera	87 87 or 89
Siphlonuridae: genus	
Baetidae	
Baetis: species All	
others: genus	
Heptageniidae Stenonema:	
species	26, 87, or 89
All others: genus	
Leptophlebiidae: genus	49
Ephemerellidae: species	26, 87, or 89
	7
	26, 87, or 89 26, 87, or 89 1,
	2, 3, 4, 5, 88

	26, 87, or 89
	26, 87, or 89
	26, 87, or 89
	26, 87, or 89
	26, 87, or 89
	26, 87, or 89
Tricorythidae: genus Caenidae:	
genus Baetiscidae: genus	87 or
Potamanthidae: genus	89
Ephemeridae: genus	87 or
Polymitarcidae: genus	89
Odonata	87 or
Gomphidae: genus Aeschnidae:	89
genus Cordulegasteridae: genus	87 or
Libellulidae: genus	89
Calopterygidae: genus	87 or
Agrionidae: genus	89
Coenagrionidae: genus	87 or
Hemiptera	89
Corixidae: genus	87 or
Plecoptera	89
Capniidae: genus Leuctridae:	87 or
genus Nemouridae: genus	89
Taeniopterygidae: species	87 or
Perlidae: species	89
Peltoperlidae: genus	87, 89, or 117
Chloroperlidae: genus	
Perlodidae: genus	87, 89, or 117
pteronarcidae: genus	
Coleoptera	87, 89, or 117
Haliplidae: genus Dytiscidae:	
family Gyrinidae: family	33
Hydrophilidae: family	38, 74, 76
Psephenidae: genus Dryopidae:	87, 89, or 117
family Scirtidae: family	
Elmidae: species	87, 89, or 117
Megaloptera	
Corydalidae: genus Sialidae:	87, 89, or 117
family	
Neuroptera	87, 89, or 117
Sisyridae: family	
Trichoptera	87, 89, or 117
Philopotamidae: genus	
Psychomyiidae: genus	87 or
Polycentropodidae: genus	89
Hydropsychidae	87 or
Hydropsyche: species	89
All others: genus	87 or
Rhyacophilidae: species	89
Glossosomatidae: genus	87 or
Hydroptilidae: genus	89
	87 or
	89
	87 or
	89
	87 or
	89
	13
	87 or
	89
	87 or
	89

Phryganeidae: genus	82, 87, or 89
Brachycentridae	
Brachycentrus: species	31
All others: genus	82, 87, or 89
Limnephilidae: genus Lepidostomatidae: genus	82, 87, or 89
Odontoceridae: genus	82, 87, or 89
Molannidae: genus	82, 87, or 89
Helicopsychidae: genus	82, 87, or 89
Leptoceridae: genus	82, 87, or 89
Lepidoptera	82, 87, or 89
Arctiidae: family	
Nepticulidae: family	87 or 89
Pyralidae: family	87 or 89
Diptera	87 or 89
Tipulidae: genus	
Psychodidae: genus	87 or 89
Ptychopteridae: genus Blephariceridae: family	87 or 89
	87 or 89
Dixidae: genus	87 or 89
Chaoboridae: genus	87 or 89
Ceratopogonidae: family	87 or 89
simuliidae: species	87 or 89
Tabanidae: family	79 or 85
Rhagionidae: family	87 or 89
Empididae: family	87 or 89
Dolichopodidae: family	87 or 89
Ephydridae: family	87 or 89
Muscidae: family	87 or 89
Anthomyiidae: family	87 or 89
Chironomidae	87 or 89
Ablabesmvia: species	62
Cricotopus: species group	72
Eukiefferiella: species group	9
Nanocladius: species	68
Orthocladius: species	73 or 81
Psectrocladius: species group	81
Tvetenia: species group	9
Dicrotendipes: species	105
Polvpedilum: species	47
Rheotanvtarsus: species group	71
Tanvtarsus: species group	71
All others: genus	81, 87, or 89

The level of taxonomy required for each group is based on these factors: differences in water quality tolerances within a group, likelihood of increased accuracy of species richness with more refined taxonomy, availability of identification keys, and history of identification of the group by the stream Biomonitoring unit.

Appendix V. SPECIES AND IDENTIFICATION REFERENCE LIST

SPECIES includes macro invertebrates collected in water quality surveys of New York State streams by the Stream Biomonitoring Unit since 1972. These are listed primarily in phylogenetic order. Classifications included for most organisms are phylum, class, order, family, genus, and species. Genera are arranged alphabetically within each family (subfamily for Chironomidae).

TOLERANCE is a listing of tolerance values for each species used in the calculation of the Hilsenhoff Biotic Index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes. Most of these values were taken from Hilsenhoff (1987). For species not included in Hilsenhoff's listing, such as Oligochaeta, values were assigned based on water quality data from Stream Biomonitoring Unit surveys and from other literature references. Values taken from survey data were assigned by taking the mean of the tolerance values of other species in the sample.

REFERENCE provides the number referring to the primary reference or references used to identify the species. These references are listed in numerical order following the species list. For references which include only keys for adult, non-aquatic stages, specimens of the larvae were reared and identified in the adult stage.]

FEEDING HABIT lists the primary feeding habit for each species, using the following abbreviations: c-f, collector-filterer; c-g, collector-gather; prd, predator; scr, scraper; and shr; shredder.
Most of these designations were taken from Merritt and Cummins (1984). In cases where more than one feeding habit is listed, the first listing was selected. For species not listed in Merritt and Cummins, other references were consulted, primarily Pennak (1978).

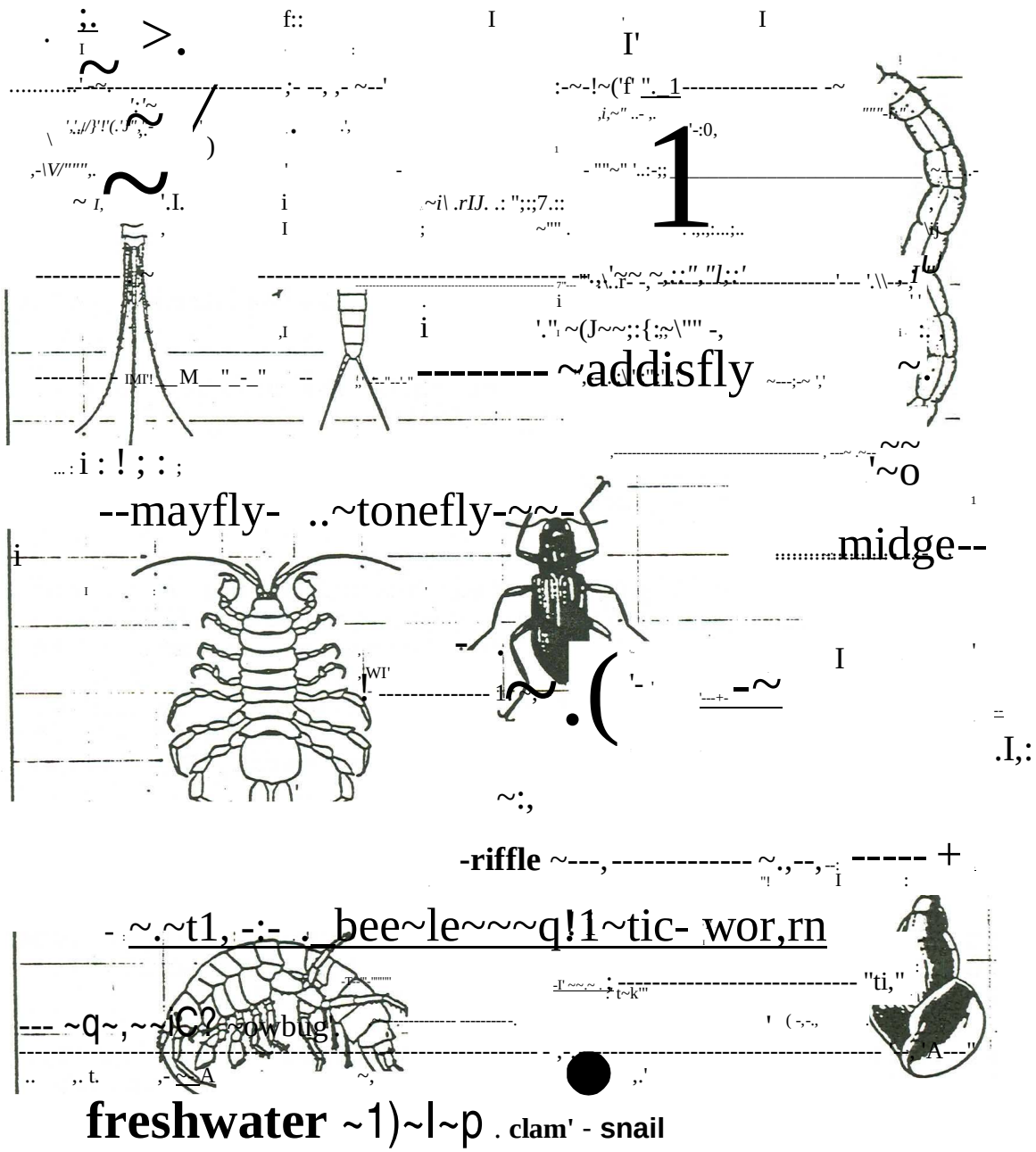
Hilsenhoff, W. L. 1987. An improved biotic index of organic stream pollution. The Great Lakes Entomologist. 20: 31-39.

Merritt, R. W., and K. W. Cummins (eds.). 1984. An introduction to the aquatic insects of North America, 2nd edition. Kendall/Hunt Publ. Co., Dubuque, Iowa. 722 pp.

Pennak, R. W. 1978. Freshwater invertebrates of the United States (2nd ed.). The Ronald Press, New York. 803 pp.

MACRO INVERTEBRATES

commonly encountered in streams'



NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION
STREAM BIOMONITORING UNIT
MACROINVERTEBRATE SPECIES LIST

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
COELENTERATA			
HYDROZOA			
HYDROIDA			
Hydridae			
Hydra sp.	5	54	prd
NEMERTEA.			
ENOPLA			
HOPLONEMERTINI			
Prostomatidae			
Prostoma graecense (=rubrum)	8	54	prd
PLATYHELMINTHES			
TURBELLARIA			
TRICLADIDA			
Planariidae			
Dugesia tigrina	6	41	prd
Dugesia sp.	6	41	prd
Undetermined Turbellaria	6	41	c-g
Undetermined Lumbricina	8	87	c-g
ANNELIDA			
POLYCHAETA			
SABELLIDA			
Sabellidae			
Manayunkia speciosa	6	20	c-g
OLIGOCHAETA			
LUMBRICINA			
Undetermined Lumbriculidae	8	37	c-g
TUBIFICIDA			
Enchytraeidae			
Undetermined Enchytraeidae sp. 1	10	12,43	c-g
Undetermined Enchytraeidae sp. 2	10	12,43	c-g
Undetermined Enchytraeidae	10	12,43	c-g
Tubificidae			
Aulodrilus americanus	8	78	c-g
Aulodrilus limnobius	8	78	c-g
Aulodrilus piqueti	8	78	c-g
Aulodrilus pluriseta	8	78	c-g
Aulodrilus sp.	8	78	c-g
Branchiura sowerbyi	10	78	c-g
Lumbriculus sp.	8	37	c-g
Stylodrilus heringianus	8	37	c-g

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Tubificidae			
Ilyodrilus templetoni Isochaetides	10	78	c-g
freyi	10	78	c-g
Limnodrilus cervix	10	78	c-g
Limnodrilus claparedeianus	10	78	c-g
Limnodrilus hoffmeisteri Limnodrilus	10	78	c-g c-
profundicola Limnodrilus udekemianus	10	78	g
Peloscolex sp.	10	78	c-g
Quistadrilus multisetosus	10	78	c-g
Spirosperma ferox	10	78	c-g
Tubifex tubifex	10	78	c-g
Undet. Tubificidae w/ cap. setae	10	78	c-g
Undet. Tubificidae *w/o* cap. setae	10	78	c-g
Naididae	10	78	c-g
Amphichaeta americana? Arcteonais			
lomondi	6	37	c-g
Chaetogaster diaphanus Chaetogaster	6	37	c-g
diastrophus Chaetogaster limnaei	6	37	prd
Chaetogaster setosus Chaetogaster	6	37	prd
sp.	6	37	prd
Dero digitata	6	37	prd
Dero furcata	6	37	prd
Dero nivea	10	37	c-g
Dero obtusa	10	37	c-g
Dero pectinata	10	37	c-g
Dero sp.	10	37	c-g
Haemonais waldvogeli	10	37	c-g
Nais barbata	10	37	c-g
Nais behningi	8	37	c-g
Nais bretscheri	8	37	c-g
Nais communis	6	37	c-g
Nais elinguis	6	37	c-g
Nais pardalis	8	37	c-g
Nais simplex	10	37	c-g
Nais variabilis	8	37	c-g
Nais sp.	6	37	c-g
Ophidonais serpentina	10	37	c-g
pristina aequiseta pristina	8	37	c-g
breviseta pristina leidyi	6	37	c-g
pristina menoni	8	37	c-g
pristina sp.	8	37	c-g c-
Pristinella jenkinae	8	37	g c-g
pristinella osborni	8	37	c-g c-
pristina/pristinella spp.	8	37	g c-g
Ripistes parasita Slavina	10	37	c-g c-
appendiculata Specaria	10	37	f c-g
josinae Stylaria lacustris	10	37	c-g c-
	8	37	g
	6	37	
	6	37	
	8	37	

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Naididae			
Vejdovskyella comata	4	37	c-g
Vejdovskyella intermedia	4	37	c-g
Vejdovskyella sp.	4	37	c-g
HIRUDINEA			
RHYNCHOBDELLIDA			
Glossiphoniidae			
Batracobdella phalera Helobdella	7	42	prd
elongata Helobdella stagnalis	7	42	prd
Helobdella triserialis	7	42	prd
Placobdella montifera	7	42	prd
Undetermined Hirudinea	7	42	prd
APHANONEURA	7	42	prd
AEOLOSOMATIDA			
Aeolosomatidae			
Aeolosoma headleyi?			
Aeolosoma leidyi?	8	20	c-f c-f
Aeolosoma quarternarium?	8	20	c-f
Aeolosoma tenebrarum? Aeolosoma	8	20	c-f
travancorense? Undetermined	8	20	c-f
Aeolosomatidae	8	20	c-f
BRANCHIOBDELLIDA	8	20	
BRANCHIOBDELLIDA			
Branchiobdellidae			
Branchiobdella sp.			
Undetermined Branchiobdellidae	6	54	c-g c-g
	6	54	
MOLLUSCA			
GASTROPODA			
BASOMMATOPHORA			
Physidae			
Physa elliptica	8	35,16	c-g
Physa gyrina	8	35,16	c-g
Physa heterostropha Physa	8	35,16	c-g
integra	8	35,16	c-g
Physa sayii	8	35,16	c-g
Physa sp.	8	35,16	c-g
LYmnaeidae	6	35,16	c-g
LYmnaea humilis	6	35,16	c-g
LYmnaea humilis	6	35,16	c-g
LYmnaea palustris LYmnaea	6	35,16	c-g
stagnalis Pseudosuccinea	6	35,16	c-g
columella Radix auricularia	6	35,16	c-g
Stagnicola catascopium	6	35,16	c-g
Undetermined LYmnaeidae	6	35,16	c-g
Planorbidae	6	35,16	c-g
Gyraulus hirsutus Gyraulus	6	35,16	c-g
parvus Helisoma campanulata	8	35,16	scr
	8	35,16	scr
	6	35,16	scr

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Planorbidae			
Helisoma trivo1vis	6	35,16	scr
Menetus di1atatus	6	35,16	scr
Undetermined Planorbidae	6	35,16	scr
Ancy1idae			
Ferrissia rivularis	6	35,16	scr
MESOGASTROPODA			
Viviparidae			
Campe10ma decisa	6	35,16	scr
Viviparus georgianus	6	35,16	scr
Pleuroceridae			
Goniobasis livescens	6	35,16	scr
Goniobasis virginica	6	35,16	scr
Goniobasis sp.	6	35,16	scr
Pleurocera acuta	6	35,16	scr
Undetermined Pleuroceridae	6	35,16	scr
Hydrobiidae			
Amnicola integra	5	35,16	scr
Amnicola limosa	5	35,16	scr
funicola lustrica	5	35,16	scr
Amnicola sp.	5	35,16	scr
Bithynia tentaculata	8	35,16)	scr
Pomatiopsis lapidaria	8	35;16	scr
Probythinella lacustris	8	35,16	scr
Undetermined Hydrobiidae	8	35,16	scr
Valvatidae			
Valvata lewisi	8	35,16	scr
Valvata piscinalis	8	35,16	scr
Valvata sincera	8	35,16	scr
Valvata tricarinata	8	35,16	scr
PELECYPODA			
UNIONIDA			
Unionidae			
Anodonta cataracta	6	21,15	c-f
Anodonta implicata	6	21,15	c-f
Elliptio complanatus	8	21,15	c-f
Lampsilis radiata radiata	6	21,15	c-f
VENEROIDEA			
Dreisseniidae			
Dreissena polymorpha	8	54	c-f
Sphaeriidae			
Musculium partumeium	6	14,45	c-f
Musculium transversum	6	14,45	c-f
Musculium sp.	6	14,45	c-f
pisidium amnicum	6	14,45	c-f
pisidium casertanum	6	14,45	c-f
Pisidium compressum	6	14,45	c-f
pisidium variabile	6	14,45	c-f
pisidium sp.	6	14,45	c-f
Sphaerium corneum	6	14,45	**c-f**
Sphaerium striatinum	6	14,45	c-f

- - --

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
,Sphaeriidae I Sphaerium sp.			
Undetermined Sphaeriidae	6	14,45	c-f
	6	14,45	c-f
ARTHROPODA			
CRUSTACEA			
ISOPODA			
Anthuridae			
Cyathura pol ita	5	114	c-g
Idoteidae			
Chiridotea almyra	5	114	c-g
Edotea sp.	5	114	c-g
Asellidae			
Caecidotea communis	8	54	c-g
Caecidotea racovitzai Caecidotea	8	54	c-g
racovitzai racovitzai Caecidotea	8	54,83,84	c-g
nr. racovitzai Caecidotea sp.	8	54,83,84	c-g
Lirceus sp.	8	54	c-g
AMPHIPODA	8	84	c-g
Gammaridae			
Gammarus fasciatus			
Gammarus pseudolimnaeus Gammarus	6	11,40)	c-g
tigrinus	4	11,40	c-g
Gammarus sp.	6	11,40	c-g
Oedicerotidae	6	11,40	c-g
Monoculodes edwardsi			
Talitridae	5	11	c-g
Hyalella azteca			
CUMACEA	8	11	c-g
Almyracuma proximoculi	5	114	c-g
DECAPODA			
Cambaridae			
Cambarus sp. Orconectes	6	22,39	c-g
obscurus Orconectes sp.	6	22,39	c-g
Undetermined Cambaridae	6	22,39	c-g
ARACHNOIDEA	6	22,39	c-g
Arrenuridae			
Arrenurus sp.	6	54	prd
Lebertiidae			
Lebertia sp.	6	54	prd
Atractideidae			
Atractides sp.	6	54	prd
Mideopsidae			
Mideopsis sp.	6	54	prd
Tyrellidae			
Tyrellia sp.	6	54	prd

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Limnesidae			
Limnesia sp.	6	54	prd
Limnocharidae			
Limnochares sp.	6	54	prd
Sperchonidae			
Sperchon sp.	6	54	prd
Unionicolidae			
Unionicola sp. 1	6	54	prd
Unionicola sp. 2	6	54	prd
Undetermined Acariformes	6	54	prd
INSECTA			
COLLEMBOLA			
Isotomidae			
Isotomurus palustris	5	87	c-g
EPHEMEROPTERA			
Siphlonuridae			
Ameletus ludens	0	87,26	c-g c-g c-g
Ameletus sp.	0	87	c-g
Isonychia bicolor Isonychia obscura siphlonurus sp.	2	44	c-g c-g
	2	44	c-g
Baetidae	7	87	
Acentrella sp.	4	87	scr
Baetis amplus	6	49	c-g
Baetis brunneicolor Baetis flavistriga Baetis	4	49	c-g
intercalaris Baetis macdunnoughi Baetis pluto	4	49	c-g
Baetis propinquus Baetis pygmaeus	6	49	c-g
	5	49	c-g
Baetis tricaudatus Baetis sp.	6	49	c-g
	6	49	c-g c-g c-g
Callibaetis sp.	4	49	c-g
centroptilum sp.	6	49	c-g
Cloeon sp.	6	49	c-g
Heterocloeon curiosum	9	87	c-g
Undetermined Baetidae	2	87	c-g
Heptageniidae	4	87	scr
Cinygmula subaequalis	2	87,26	c-g
Epeorus (Iron) sp.	6	87	
Heptagenia cuI acantha	2	87	scr
Heptagenia flavescens	0	87	scr
Heptagenia marginal is	2	28	scr
Heptagenia pulla gr.	4	17	scr
Heptagenia sp.	4	17	scr
Leucrocuta sp.	4	17	scr
Nixe (Nixe) sp.	4	17	scr
Rithrogena sp.	1 2	32	scr
	0	32	scr
		87	c-g

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Heptageniidae			
Stenacron interpunctatum	7	7	scr
Stenonema exiguum	5	7	scr
Stenonema femoratum	7	7	scr
Stenonema integrum	4	7	scr
Stenonema ithaca	3	7	scr
Stenonema mediopunctatum	3	7	scr
Stenonema meririvulanum	2	7	scr
Stenonema modestum	1	7	scr
Stenonema pulchellum	3	7	scr
Stenonema terminatum	4	7	scr
Stenonema vicarium	2	7	scr
Stenonema sp.	3	7	scr
Undetermined Heptageniidae	3	87	scr
Leptophlebiidae			
Choroterpes sp.	2	87	c-g
Habrophlebia vibrans	4	26	c-g
Habrophlebia sp.	4	87	c-g
Habrophlebiodes sp.	6	87	scr
Leptophlebia sp.	4	87	c-g
Paraleptophlebia guttata	1	17	c-g
Paraleptophlebia mollis	1	17	c-g
Paraleptophlebia sp.	1	87	c-g
Undetermined Leptophlebiidae	4	87	c-g
Ephemerellidae			
Attenella attenuata	1	88	c-g
Attenella margarita	1	88	c-g
Dannella simplex	2	1	c-g
Dannella sp.	2	1	c-g
Drunella cornuta	a	2	c-g
Drunella cornutella	a	2	scr
Drunella lata	a	2	scr
Drunella tuberculata.	a	2	scr
Drunella walkeri	a	2	scr
Ephemerella aurivillii	a	5	c-g
Ephemerella dorothea	1	5	c-g
Ephemerella excrucians?	1	5	c-g
Ephemerella invaria	1	5	c-g
Ephemerella needhami	1	5	c-g
Ephemerella rotunda	1	5	c-g
Ephemerella subvaria	1	5	c-g
Ephemerella sp.	1	5	c-g
Eurylophella funeralis	a	4	c-g
Eurylophella temporalis	5	4	c-g
Eurylophella verisirnilis	2	4	c-g
Eurylophella sp.	2	4	c-g
Serratella deficiens	2	3	c-g
Serratella serrata	2	3	c-g
Serratella serratoides	2	3	c-g
Serratella sordida	2	3	c-g
Serratella sp.	2	3	c-g

SPECIES	TOLERANCE	REFERENCE		FEEDING HABIT
Ephemerellidae				
Undetermined Ephemerellidae	2	87		c-g
Tricorythidae				
Tricorytodes Spa	4	87		c-g
Caenidae				
Brachycercus Spa	3	87		c-g
Caenis Spa	7	46		c-g
Baetiscidae				
Baetisca Spa	4	87,26		c-g
Potamanthidae				
Potamanthus verticis	4	48		c-g
Potamanthus Spa	4	48		c-g
Ephemeridae				
Ephemera guttulata	2	48		c-g
Ephemera Spa	2	48		c-g
Hexagenia Spa	6	48		c-g
Polymitarcyidae				
Ephoron leukon?	2	26		c-g
0 DONATA				
Gomphidae				
Gomphus Spa	5	80		prd
Lanthus Spa	5	80	J	prd
Ophiogomphus Spa	1	80		prd
Stylurus Spa	4	80		prd
Undetermined Gomphidae	4	80		prd
Aeschnidae				
Basiaeschna janata	6	80		prd
Boyeria Spa	2	80		prd
Cordulegasteridae				
Cordulegaster Spa	3	80		prd
Libellulidae				
Macromia Spa	2	80		prd
Neurocordulia Spa	2	80		prd
Calopterygidae				
Calopteryx sp..	6	80		prd
Undetermined Calopterygidae	6	80		prd
Agrionidae				
Hetaerina Spa	6	80		prd
Undetermined Agrionidae	6	80		prd
Coenagrionidae				
Argia Spa	6	80		prd
Enallagma Spa	8	80		prd
Ischnura Spa 1	9	80		prd
Ischnura Spa 2	9	80		prd
Ischnura Spa 3	9	80		prd
Ischnura Spa 4	9	80		prd
Ischnura Spa 5	9	80		prd
Ischnura Spa	9	80		prd
Undetermined Coenagrionidae	8	80		prd

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT,
HEMIPTERA			
Corixidae	5	87	prd
Hesperocorixa sp.	5	87	prd
Undetermined Corixidae	3	64,117	shr
PLECOPTERA			
Capniidae	3	64,117	shr
Allocapnia vivipara	1	117	shr
Allocapnia sp. Paracapnia sp. Undetermined Capniidae	3	117	shr
Leuctridae	0	91,117	shr
Leuctra ferruginea Leuctra tenuis	0	91,117	shr
Leuctra sp.	0	117	shr
Zealeuctra sp.	0	117	shr
Undetermined Leuctridae	0	117	shr
Nemouridae	3	92,117	shr
Amphinemura	3	92,117	shr
Amphinemura delosa	3	92,117	shr
Amphinemura nigritta		117	shr
Nemoura sp. wui	1		
Ostrocerca sp.	2	117	shr
Shipsa rotunda	2	117	shr
Undetermined Nemouridae	2	117	shr
Taeniopterygidae	3	116,117	shr
Str9phopteryx fasciata	2	33,117	shr
Taeniopteryx burksi	2	33,117	shr
Taeniopteryx lonicera	2	33,117	shr
Taeniopteryx nivalis	2	117	shr
Taeniopteryx parvula	0	76,117	prd
Taeniopteryx sp.	0	76,117	prd
Perlidae	0	117	prd
Acroneuria abnormis	2	74,117	prd
Acroneuria carolinensis	2	74,117	prd
Acroneuria lycorias	2	117	prd
Acroneuria sp.	3	77	prd
Agnetina capitata Agnetina flavescens Agnetina sp.	3	117	prd
Claasenia? sp.	1	38,117	prd
Neoperla sp. Paragnetina	1	38,117	prd
immarginata Paragnetina	5	38,117	prd
media Perlesta placida	3	117	prd
Undetermined Perlidae	0	117	shr
Peltoperlidae	0	117	c-g
Tallaperla sp.	1	117	prd
Chloroperlidae			
Alloperla sp.			
Haploperla brevis			

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chloroperlidae			
Rasvena terna	0	117	c-g
Suwallia sp.	0	117	prd
Sweltsa sp.	0	117	prd
Undetermined Chloroperlidae	0	117	prd
Perlodidae			
Cultus decisus	2	117	prd
Helopicus subvarians	2	112,117	prd
Isogenoides hansoni	0	112	prd
Isoperla holochlora	2	38,117	prd
Isoperla namata	2	38	prd
Isoperla transmarina	2	38,117	prd
Isoperla sp.	2	77,117	prd
Malirekus iroquois	2	112,117	prd
Undetermined Perlodidae	2	117	prd
pteronarcidae			
pteronarcys biloba	0	112,117	shr
pteronarcys dorsata	0	116,117	shr
pteronarcys proteus	0	112,117	shr
pteronarcys sp.	0	117	shr
COLEOPTERA			
Haliplidae			
Haliplus sp.	5	96,87	shr
Peltodytes sp.	5	96,87	shr
Dytiscidae			
Agabetes sp.	5	96,87	prd
Agabus sp.	5	96,87	prd
Hydroporous sp.	5	96,87	prd
Laccophilus sp.	5	96,87	prd
Undetermined Dytiscidae	5	96,87	prd
Gyrinidae			
Dineutus sp.	4	96,87	prd
Hydrophilidae			
Berosus sp.	5	96,87	prd
Helochares sp.	5	96,87	prd
Helophorus sp.	5	96,87	shr
Hydrobius sp.	5	96,87	prd
Laccobius sp.	5	96,87	prd
Psephenidae			
Ectopria nervosa	5	13	scr
Ectopria sp.	5	13	scr
Psephenus herricki	4	13	scr
Psephenus sp.	4	13	scr
Dryopidae			
Helichus sp.	5	13,87,96	scr
Scirtidae			
Undetermined Scirtidae	5	87	scr
-Elmidae			
Ancyronyx variegatus	5	13	c-g
Dubiraphia bivittata	6	13	c-g

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Elmidae	6		
Dubiraphia vittata Dubiraphia	6	13	c-g
sp. Macronychus glabratus	5	13	c-g
optioservus fastiditus	4	13	shr
optioservus immunis	4	13	scr
Optioservus ovalis	4	13	scr
optioservus nr. sandersoni	4	13	scr
Optioservus trivittatus	4	13	scr
optioservus sp.	4	13	scr
Oulimnius latiusculus	4	13	scr
promoresia elegans promoresia	2	13	scr
tardella promoresia sp.	2	13	scr
Stenelmis bicarinata	2	13	scr
Stenelmis concinna Stenelmis	5	13	scr
crenata Stenelmis markeli	5	13	scr
Stenelmis musgravei Stenelmis	5	13	scr
sp. Undetermined Elmidae	5	13	scr
MEGALOPTERA	5	13	scr
Corydalidae	5	13	scr
Chauliodes sp.	5	13	scr
corydalus cornutus Nigronia	5	13	scr
serricornis	5	13	scr
Sialidae			
Sialis sp.	4	13	scr
NEUROPTERA			
Sisyridae	4	27	prd
Climacia areolaris	0	27	prd
TRICHOPTERA			
Philopotamidae	4	27,50	prd
Chimarra aterrima? Chimarra			
socia		27	prd
Chimarra obscura? Chimarra	5		
sp.		27	prd
Dolophilodes sp.	4		
psychomyiidae			
Lype diversa	4	63	c-f
psychomyia flavida	4	63	c-f
polycentropodidae	4	63	c-f
Cyrnellus fraternus Cyrnellus	0	63,82	c-f
sp. 2 Neureclipsis bimaculata	2	63,82	c-f
Neureclipsis sp. Nyctiophylax			
celta Nyctiophylax moestus	2	30	scr
Phylocentropus sp.	8	30	c-g
polycentropus remotus	8	30	c-f
polycentropus sp.	7	30	c-f
	7	30	c-f
	5	30	c-f
	5	30	prd
	5	30	prd
	6	30	c-f
	6	30	prd
		30	prd

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Hydropsychidae			
Arctopsyche sp. Cheumatapsyche sp. Diplectrona sp. Hydropsyche betteni Hydropsyche bronta Hydropsyche nr. depravata Hydropsyche dicantha Hydropsyche leonardi Hydropsyche morosa Hydropsyche orris Hydropsyche phalerata Hydropsyche recurvata Hydropsyche scalar is Hydropsyche separata Hydropsyche slossonae Hydropsyche sparna Hydropsyche valanis Hydropsyche venularis Hydropsyche sp. Macrostemum carolina Macrostemum zebratum Macrostemum sp. Parapsyche sp. potamyia sp. Undetermined Hydropsychidae	1	82	c-f
Rhyacophilidae			
Rhyacophila carolina gr.	5	82	c-f
Rhyacophila carpenteri?	0	82	c-f
Rhyacophila fuscula	6	70	c-f
Rhyacophila glaberrima	6	70	c-f
Rhyacophila melita Rhyacophila nigrita Rhyacophila sp.	6	70	c-f
Glossosomatidae			
Agapetus sp.	2	70	c-f
Glossosoma sp.	0	70	c-f
Protoptila sp.	6	69,70	c-f
Hydroptilidae			
Agraylea sp.	5	70	c-f
Alisotrichia sp. Hydroptila ajax?	1	70	c-f
Hydroptila nr. albicornis sp. 1	4	70	c-f
Hydroptila nr. albicornis sp. 2	2	70	c-f
Hydroptila nr. albicornis sp. 3	4	70	c-f
Hydroptila nr. armata	4	70	c-f
Hydroptila consimilis?	6	70	c-f
Hydroptila nr. grandiosa	6	70	c-f
Hydroptila nr. hamata sp. 1	4	70	c-f
Hydroptila nr. hamata sp. 2	4	70 J	c-f
	3	63	c-f
	3	63	c-f
	3	63	c-f
	0	82	c-f
	5	82	c-f
	5	82	c-f
	1	29	prd
	1	29	prd
	0	29	prd
	1	29	prd
	1	29	prd
	1	29	prd
	1	29	prd
	0	82	scr
	0	82	scr
	1	82	scr
	8	82	c-g
	6	82	scr
	6	63	scr
	6	63	scr
	6	63	scr
	6	63	scr
	6	63	scr
	6	63	scr
	6	63	scr
	6	63	scr

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Hydroptilidae			
Hydroptila spatulata?	6	63	scr
Hydroptila nr. waubesiana	6	63	scr
Hydroptila sp.	6	63	scr
Ithytrichia sp. Leucotrichia	4	63	scr
sp. Mayatrichia ayama	6	63	scr
Neotrichia sp.	6	63	scr
Orthotrichia sp.	2	63	scr
Oxyethira sp.	6	63	shr
Palaeagapetus celsus	3	63	c-g
Palaeagapetus sp.	4	82	shr
Phryganeidae	1	82	shr
Oligostomis ocelligera			
ptilostomis sp.	2	82	prd
Brachycentridae	5	82	shr
Adicrophleps hitchcocki			
Brachycentrus appalachia	2	82	shr
Brachycentrus incanus	0	31	c-f
Brachycentrus lateralis	0	31	c-f
Brachycentrus numerosus	1	31	c-f c-
Brachycentrus solomoni	1	31	f c-f
Micrasema sp. 1	1	31	shr
Mierasema sp. 2	2	31	shr
Micrasema sp. 3	2	31	shr
Undetermined Brachycentridae	2	31	shr
Limnephilidae	2	31,82	
Apatania ~p~			
Goera sp.	3	82	scr
Hesperophylax designatus	3	82	scr
Hydatophylax sp. Nemotaulius	3	82	shr
sp.	2	82	shr
Neophylax concinnus Neophylax	3	82	scr
fuscus	3	82	scr
Neophylax sp. Platycentropus	3	82	scr
sp. Pseudostenophylax sp.	3	82	scr
Psychoglypha sp. Pycnopsyche	4	82	shr
sp. Undetermined Limnephilidae	0	82	shr
Lepidostomatidae	0	82	c-g
Lepidostoma sp.	4	82	shr
Odontoceridae	4	82	shr
Psilotreta sp.			
Molannidae	1	82	shr
Molanna sp.			
Helicopsychidae	0	82	scr
Helicopsyche borealis			
Helicopsyche sp.	6	82	scr
	3	82	scr
	3	82	scr

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Leptoceridae			
Ceraclea punctata	3	55	c-g
Ceraclea sp.	3	55	c-g
Mystacides sepulchral is	4	86	c-g
Mystacides sp.	4	86	c-g
Nectopsyche sp.	3	34	shr
Oecetis avara	5	63	prd
Oecetis cinerascens	5	63	prd
Oecetis inconspicua	5	63	prd
Oecetis sp.	5	63	prd
Setodes sp.	2	82	c-g
Triaenodes sp.	6	82	shr
Undetermined Leptoceridae	4	82	prd
LEPIDOPTERA			
Arctiidae			
Estigmene sp.	5	121	shr
Nepticulidae			
Undetermined Nepticulidae	5	121	shr
Pyralidae			
Acentria sp.	5	121 J	shr
Nymphula sp.	7	121	shr
Parapoynx sp.	5	121	shr
Petrophila sp.	5	121	scr
Undetermined Lepidoptera	5	121	shr
DIPTERA			
Tipulidae			
Antocha sp. 1	3	95	c-g
Antocha sp. 2	3	95	c-g
Antocha sp.	3	95	c-g
Dicranota sp.	3	95	prd
Helius sp.	4	95	c-g
Hexatoma sp. 1	2	95	prd
Hexatoma sp. 2	2	95	pre!
Hexatoma sp.	2	95	prd
Limonia sp.	6	95	shr
pilaria sp.	7	95	prd
Tipula sp.	4	95	shr
Undetermined Tipulidae	4	95	shr
Psychodidae			
pericoma sp.	4	94	c-g
Undetermined Psychodidae	10	94	c-g
Ptychopteridae			
Bittacomorpha clavipes	9	87	c-g
Blephariceridae			
Undetermined Blephariceridae	0	94	scr
Dixidae			
Dixa sp.	1	111	c-f

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chaoboridae			
Chaoborus punctipennis	8	111	prd
Ceratopogo.nidae			
Bezzia sp. 1	6	36,87	prd
Bezzia sp. 2	6	36,87	prd
Culicoides? sp.	10	36,87	prd
Forcipomyia sp.	6	36,87	scr
Probezzia sp. 1	6	36,87	prd
Probezzia sp. 2	6	36,87	prd
Sphaeromais longipennis	6	36,87	prd
Undetermined Ceratopogonidae	6	36,87	prd
simuliidae			
Cnephia mutata	2	79	c-f c-
prosimulium hirtipes	2	79,85	f
prosimulium magnum prosimulium	1	79,85	c-f
rhizophorum simulium aureum	2	79,85	c-f
Simulium decorum	7	79,85	c-f
Simulium fibrinflatum Simulium	7	79,85	c-f c-
gouldingi	6	79,85	f c-f
Simulium jenningsi	3	79,85	c-f c-
Simulium latipes	4	79,85	f c-f
Simulium parnassum	4	79,85	c-f c-
Simulium pictipes	7	79,85	f c-f
Simulium rugglesi	4	79	c-f c-
Simulium tuberosum	5	79,85	f c-f
Simulium venustum	4	79,85	
Simulium vittatum	5	79,85	
Simulium sp.	7	79,85	
Tabanidae	5	79,85	
Chrysops sp.			
Tabanus sp.	5	94 111	c-g
Undetermined Tabanidae	5	94	prd
Rhagionidae	5		prd
Atherix sp.			
Empididae	4	94	prd
Chelifera sp.			
Clinocera sp.	6	94	prd
Hemerodromia sp. Wiedemannia?	6	94	prd
sp.	6	94	prd
Dolichopodidae	6	94	prd
Undetermined Dolichopodidae			
Ephydiidae	4	94	prd
Hydrellia sp.			
Muscidae	6	111	shr
Undetermined Muscidae			
Anthomyiidae	6	94	prd
Undetermined Anthomyiidae	6	87,94	prd

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae			
Tanypodinae			
Ablabesmyia annulata	8	62	prd
Ablabesmyia mallochi	8	62	prd
Ablabesmyia monilis	8	62	prd
Ablabesmyia philosphagnos	8	62	prd
Ablabesmyia simpsoni	8	62	prd
Ablabesmyia sp. Clinotanypus	8	62	prd
pinguis Coelotanypus	8	110	prd
scapularis Conchapelopia	4	59,101	prd
aleta conchapelopia americana	6	61	prd
Conchapelopia dusena	6	61	prd
Conchapelopia flavifrons	6	61	prd
Conchapelopia goniodes	6	61	prd
Conchapelopia rurika	6	61	prd
Conchapelopia telema	6	61	prd
Conchapelopia sp.	6	61	prd
Guttipelopia guttipennis	6	61 119	prd
Hayesomyia senata Helopelopia	5	61,97	prd
cornuticaudata Hudsonimyia	6	61,811	prd
karelena Hudsonimyia parrishi	6	19	prd
Labrundinia pilosella	2	19	prd
Labrundinia nr. virescens	2	99	prd
Larsia canadensis Natarsia	7	99	prd
sp. A	7	8	prd
Natarsia baltimoreus	6	100	prd
Nilotanypus fimbriatus	8	100	prd
Nilotanypus sp.	8	98	prd
paramerina sp.	8	98	prd
Pentaneura inconspicua?	6	81	prd
procladius bellus Procladius	6	101	prd
sublettei Psectrotanypus	6	60 60	prd
dyari Rheopelopia perda?	9	100	prd
Rheopelopia sp. 2	9	61	prd
Rheopelopia sp. 3	10	61	prd
Tanypus punctipennis Tanypus	4	61	prd
stellatus Telopelopia	4	58	prd
okoboji Thienemannimyia gr.	4	58	prd
spp. Thienemannimyia norena	10	61	prd
Trissopelopia ogemawi	10	61	prd
Zavrelimyia sinuosa	8 6	61	prd
Zavrelimyia sp. Undetermined	6 4	61	prd
Tanypodinae	8 8	101 81	prd
podonominae	7	81	prd
Paraboreochlus sp.			prd
Diamesinae			prd
			prd
	1	81	c-g

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae			
Diamesinae			
Diamesa spp.	5	2	c-g
pagastia sp. A	1 2	4	c-g
Potthastia gaedii	2	2	c-g
Potthastia longimana Pseudokiefferiella	1 2	4	c-g
sp.	2	2	c-g
Sympotthastia sp.		4	c-g
Undetermined Diamesinae		2	c-g
prodiamesinae		4	
Monodiamesa dipectinata	7	24	c-g
prodiamesa sp. 1	3	24,25	c-g
prodiamesa sp. 2	3	24	c-g
Orthocladiinae			
Acricotopus sp.	10	81	c-g
Brillia flavifrons	5	52	shr
Brillia parva	5	52	shr
Brillia sera	5	52	shr
Brillia sp.	5	52	shr
Cardiocladius albiplumus Cardiocladius	5	51	prd
obscurus Chaetocladius vitellinus gr.	5	71	prd c-
Corynoneura celeripes	6	81	g
Corynoneura taris	4	71	c-g c-g c-
Corynoneura sp.	4	71	g c-g
Cricotopus bicinctus	4	81	shr
Cricotopus nr. cylindraceus Cricotopus	7	72	shr c-
elegans	7	72	g shr
Cricotopus festivellus gr. Cricotopus	7	72	shr
intersectus gr. Cricotopus reversus gr.	7	72	shr
Cricotopus sylvestris gr. cricotopus	7	72	shr
tremulus gr.	7	72	shr
Cricotopus triannulatus	7	72	shr
Cricotopus trifascia gr.	7	72	shr
Cricotopus vierriensis	7	72	c-g c-g
Diplocladius sp.	6	72	c-g
Epoicocladius sp.	7	72	c-g c-g c-
Eukiefferiella brehmi gr.	8	81	g c-g c-g
Eukiefferiella brevicalcar gr.	4	81	c-g c-g c-
Eukiefferiella claripennis gr.	4	9	g c-g c-g
Eukiefferiella coerulescens gr.	4	9	c-g c-g
Eukiefferiella devonica gr.	8	9	
Eukiefferiella gracei gr.	4	9	
Eukiefferiella pseudomontana gr.	4	9	
Heterotrissocladius marcidus gr.	4	9	
Hydrobaenus pilipes	8	9	
Krenosmittia sp.	4	66	
Limnophyes sp.	8	67	
Lopescladius sp.	1	81	
Nanocladius (Plecopteracoluthus) sp.	8	81	
	4	81	
	3	81	

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae			
Orthocladiinae			
Nanocladius nr. balticus	3	68	c-g
Nanoclad~us crassicornus	3	68	c-g
Nanocladius distinctus	3	68	c-g
Nanocladius minimus	3	68	c-g
Nanocladius rectinervis	3	68	c-g
Nanocladius spiniplenus	3	68	c-g
Nanocladius sp.	3	68	c-g
Orthocladius (Eudactylocladius) sp.	6	73	c-g
Orthocladius (Euorthoclad.) Type I spp.	6	73	c-g
Orthocladius (Euorthoclad.) rivulorum	6	73	c-g
Orthocladius annectens	6	73	c-g
Orthocladius carlatus	6	73	c-g
Orthocladius curtiseta	6	73	c-g
Orthocladius nr. dentifer	6	73	c-g
Orthocladius obumbratus	6	73	c-g
Orthocladius nr. robacki	6	73	c-g
Orthocladius trigonolabis	6	73	c-g
Orthocladius (SYmposiocladius) lignicola	6	73	..\!>'"" c-g
Orthocladius sp.	5	81	c-g
parachaetocladius sp.	6	73	c-g
Paracricotopus sp.	2	81	c-g
Parakiefferiella triquetra gr.	4	81	c-g
Parakiefferiella sp.	4	102	c-g
parametriocnemus lundbecki	4	81	c-g
Paraphaenocladius sp.	5	71	c-g
paratrichocladius sp.	4	81	c-g
Psectrocladius dilatatus gr. Psectrocladius nigrus	5	81	shr
Psectrocladius psilopterus gr.	8	81	c-g
psectrocladius sordidellus gr.	8	81	c-g
Psectrocladius vernal is	8	81	c-g
Rheocricotopus robacki	8	81	c-g
Rheocricotopus tuberculatus Rheocricotopus sp. 2	8	81	c-g
Rheocricotopus sp. 4	6	71	c-g
Synorthocladius nr. semivirens	6	18	c-g
Thienemanniella nr. fusca Thienemanniella xena?	6	81	c-g
Thienemanniella sp.	6	71	c-g
Trissocladius sp.	6	71	c-g
Tvetenia bavarica gr.	6	81	c-g
Tvetenia vitracies	5	81	c-g
Unniella multi virga	5	9	c-g
Zalutschia zalutschicola	5	9,115	c-g
Undetermined Orthocladiinae	4	103	c-g
Chironominae	6	67	shr
Axarus festivus gr.	5	81	c-g
Chironomus decorus gr.	6	57,81	c-g
Chironomus riparius gr.	10	53	c-g
	10	53	c-g

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae	10	53	c-g
Chironominae	9	81	c-g
Chironomus sp.	8	23	prd
C1adope1ma sp.	8	23	prd
Cryptochironomus fu1vus gr.	6	104	c-g
Cryptochironomus ponderosus	6	104	c-g
Cryptotendipes casuarius	6	104	c-g
Cryptotendipes emorsus	6	81	c-g
Cryptotendipes pseudotener	8	81	c-g
Cryptotendipes sp.	8	81	c-g
Demicryptochironomus sp. 1	8	105	c-g
Demicryptochironomus cuneatus	8	105	c-g
Dicrotendipes fumidus Dicrotendipes	8	105	c-g
1ucifer Dicrotendipes modestus	8	105	c-g
Dicrotendipes neomodestus	8	105	c-g
Dicrotendipes simpsoni	9	81	c-g
Einfe1dia sp.	10	106,71	shr
Endochironomus nigricans	10	106,71	shr
Endochironomus subtendens	10	81	shr
Endochironomus sp.	10	71	shr
G1yptotendipes lobiferus	10	81	shr
G1yptotendipes sp. 2	8	81	c-g
Goe1dichironomus sp.	8	71	c-g
Harnischia curti1ame11ata	8	81	c-g
Microchironomus sp. Microtendipes	6	81	c-f
ryda1ensis gr. Microtendipes	6	81	c-f
pede11us gr. Ni10thauma babiyi	2	71	c-g
Parachironomus abortivus	10	71	prd
parachironomus carinatus	10	71	prd
parachironomus frequens	10	71	prd
parachironomus hirta1atus	10	71	prd
parachironomus sp. Parac1adope1ma	10	71	prd
nais Para1auterbornie11a	10	71	prd
nigroha1teris Para1auterbornie11a	7	107	c-g
sp. Paratendipes a1bimanus	8	108	c-g
Phaenopsectra dyari? ppaenopsectra	8	81	c-g
f1avipes Phaenopsectra sp.	6	71	c-g
Po1ypedi1um aviceps	7	71	scr
Po1ypedi1umconvictum Po1ypedi1um	7	71	scr
digitifer Po1ypedi1um fa11ax gr.	7	81	scr
Po1ypedi1um griseopunctatum	6	47	shr
Po1ypedi1um ha1tera1e Po1ypedi1um	6	47	shr
i11inoense po1ypedi1um 1aetum	6	47	shr
Po1ypedi1um obtusum	6	47	shr
po1ypedi1um sca1aenum	6	47	shr
	6	47	shr
	6	47	shr
	6	47	shr
	6	47	shr
	6	47	shr

SPECIES	TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae			
Chironominae			
Polypedilum nr. scalaenum	6	47	shr
Polypedilum simulans gr.	6	47	shr
Polypedilum sordens	6	47	shr
Polypedilum tuberculum	6	47	shr
Pseudochironomus sp. 1	5	68	c-g
Pseudochironomus sp. 2	5	68	c-g
Pseudochironomus sp. 3	5	68	c-g
Sergentia? sp.	5	106	c-g
Stelechomyia sp.	7	81	c-g
Stenochironomus hilaris	5	10	c-g
Stenochironomus macateei	5	10	c-g
Stenochironomus poecilopterus	5	10	c-g
Stenochironomus sp. stictochironomus	5	10	c-g
sp.	9	81	c-g
Tribelos fuscicorne	5	106	c-g
Tribelos jucundum	5	106	c-g
Xenochironomus nr. rogersi	0	57	prd
Xenochironomus xenolabis Undetermined	0	57	prd
Chironomini Cladotanytarsusnr.	6	81)	c-g c-
dispersopilosus Cladotanytarsus nr.	7	56	f c-f
mancus Cladotanytarsus sp. 2	7	56	c-f c-
Cladotanytarsus sp. 4	7	56	f c-g
Constempellina sp. 1	7	56	c-g c-
Constempellina sp. 2	4	81	g c-g
Micropsectra nr. brunnipes	4	81	c-g c-
Micropsectra nr. curvicornis	7	56	g c-f
Micropsectra nr. deflecta	7	56	c-f
Micropsectra polita? Paratanytarsus	7	56	c-f
confusus Paratanytarsus dimorphis	7	56	c-f
Rheotanytarsus distinctissimus gr.	6	56	c-g
Rheotanytarsus exiguus gr.	6	56	c-g
Stempellina nr. bausei Stempellina	6	71	c-g
johannseni Stempellina nr.	6	71	c-g
subglabripennis Stempellina wirthi	2	109	c-g
Stempellina sp. 4	2	109	c-g
Stempellina sp. 5	2	109	c-g
Stempellinella sp. 1	2	109	c-g
Stempellinella sp. 2	2	109	c-g
Stempellinella sp. 3	2	109	c-f
Sublettea coffmani	4	109	c-f
Tanytarsus brundini	4	109	c-f c-
Tanytarsus eminulus gr.	4	109	f c-f
Tanytarsus glabrescens gr.	4	81	c-f c-
Tanytarsus guerlus gr.	6	56	f
Tanytarsus sp.	6	56	
Zavrelia gr. spp.	6	56	
	6	56	
	6	56	
	4	81	

SPECIES		TOLERANCE	REFERENCE	FEEDING HABIT
Chironomidae				
Chironominae				
undetermined	Tanytarsini	6	81	c-f
Undetermined	Chironominae	6	81	c-g

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