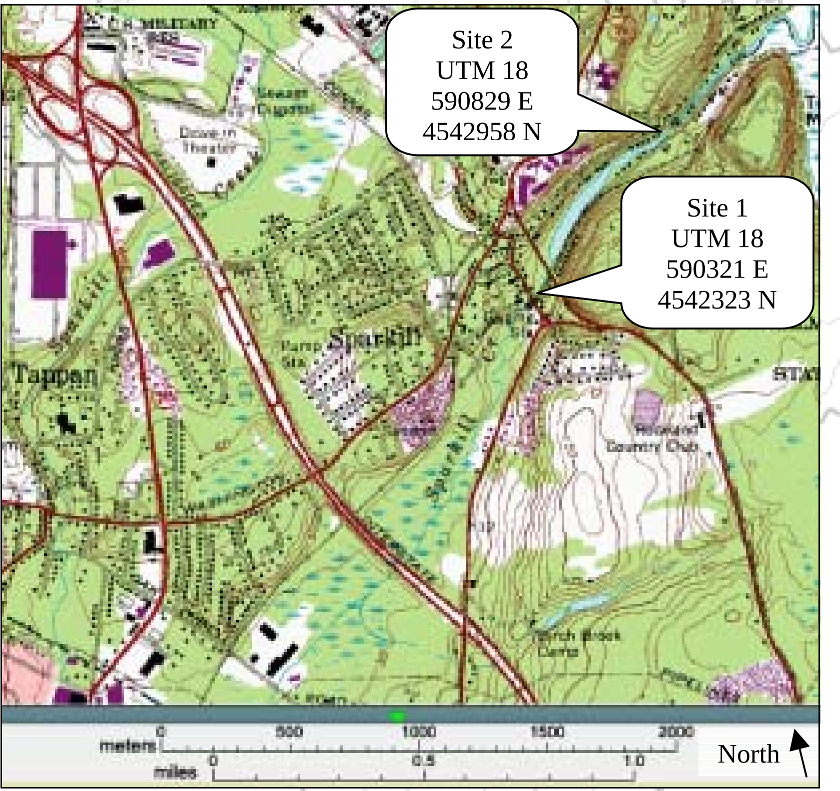
A MODIFIED RAPID BIOASSESSMENT ON THE SPARKILL, ROCKLAND COUNTY, NY

Conducted: February 19 and 20, 2002



<u>Sparkill, Rockland County, NY</u>

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Rapid Watershed Assessment Program
Hudson Basin River Watch

Contents

SUMMARY

In February 2002, Hudson Basin River Watch (HBRW) performed a modified rapid biological assessment on the Sparkill, in Rockland County, NY, as part of a stream monitoring training workshop at the Lamont Doherty Earth Observatory. Physical, chemical, and biological data were collected once on the lower reach of the kill; this data primarily fell outside the parameters established for a healthy stream. Impaired water quality of the Sparkill has also been consistently documented in several other studies over the past ten years by various environmental organizations, including the New York State Department of Environmental Conservation (NYS DEC). In conjunction with these studies, a longitudinal assessment of the testing reach was possible; and based on this data, the Sparkill should be added to the NYS DEC Impaired Waters 303(d) list. Additionally, community education on the effects of residential and urban practices on the kill and a continued monitoring effort should begin.

BACKGROUND

The Sparkill is a 7.5-mile watercourse located in Rockland County, NY and parts of New Jersey. The watershed drains approximately 11.1 square miles, with an elevation change from the headwater to its confluence with the Hudson River of some 400 feet (Stevens and Schmidt, 1993). Approximately 70% of the watershed is urban, 20% forested, and 10% wetland. Urban areas include residential, commercial, and industrial usage, all of which have the potential for altering the creek's water quality and adversely affecting its ecosystem. Two sewage treatment facilities on the NYS watercourse, and possibly another on the New Jersey watercourse, may threaten the kill. Sections of the Sparkill are classified as class C, C (T), and B, and include one class D tributary. The Sparkill is on the NYS DEC Priority Water Body List because the aquatic life is possibly stressed by suspected silt/ sediment, possibly from construction (NYS DEC Division of Water, 2000).

RESULTS

Explanation of the methods used to collect and evaluate the data obtained in this study can be found in the section on Rationale of Data Collected and Methods pages 5-8. For complete physical, chemical, and biological data see appendix I—IV. A map of site locations is on the cover.

The Hudson Basin River Watch Rapid Biological Assessment Quality Assurance Quality Control (QAQC) was developed and written following the Environmental Protection Agency (EPA) guidelines for volunteer stream monitoring programs and outlines in detail the study's organization, objectives, volunteer training requirements, methods of data collection, documentation, analysis, and quality control. The QAQC is available from the author.

A physical site assessment, biological data and chemical analysis were performed at one site. Bacteriological data were collected at two sites. The test sites were on a stretch of class C stream.

Test Site Location One: Downstream from the Valentine St. Bridge.

On physical survey, the stream received a "fair" habitat assessment rating. Dense filamentous algae were growing on 100% of the substrate and the water was milky/gray in appearance.

The pH and alkalinity were within normal range and turbidity was elevated at 2.5 JTU. Conductivity was 570 µs/cm. Nitrates (NO_3) and phosphorous (P) were elevated at 1.4 mg/l and 0.073 mg/l, respectively. Water temperature was 3.3 degrees Celsius, dissolved oxygen concentration was 10.6 mg/l and percent oxygen saturation was 81%.

Bacteriological data collected at the site included numerous bacteria, but no total coliforms or E. coli. (Additional bacterial data collected at test site two located just upstream of the Rockland Rd. and Piermont Ave. bridge, included numerous bacteria, with 1,220 total coliforms/100ml and 70 E. coli./100ml).

Biological indices for site 1 show that water quality is slightly impacted by total family richness and biotic index and moderately impacted by EPT richness and percent model affinity. There was a moderate change in the EPT/EPT + Chironomidae ratio from reference condition. The percent contribution of dominant family and percent composition of major groups were suggestive of an adverse environmental impact. Water quality is moderately impacted by biological assessment profile.

DISCUSSION

The Sparkill is a B, C, C (T) and D class stream that travels through urban areas having the potential to alter the creek's water quality and adversely affect its ecosystem. By performing a modified rapid assessment of the kill's physical, chemical and biological health at one site and combining the findings with data obtained in earlier studies, an overall assessment of the stream's health and insight into persistent water quality problems that plague the Sparkill could be obtained.

The physical assessment of the testing reach is strongly suggestive of unhealthy and impaired conditions. The filamentous algae growth occurring on the substrate alters the biotic community by providing suitable habitat for organisms that otherwise would be limited in number or nonexistent, while displacing and eliminating organisms representative of a healthy ecosystem (Stevenson et al., 1996, Hynes 1970, Mason 2002). Algae growth in the Sparkill appears to be chronic rather than episodic; Stevens and Schmidt noted heavy growth of algae and bacteria occurring on the substrate surfaces in their 1993 survey report.

This study found nitrate and phosphorus levels above natural conditions. Similarly, data that Nieder collected from June, 1991 through May, 1993 show that the mean monthly nitrate reading was over 2 times what is considered healthy for a stream (Nieder, 1995). It would appear that phosphorus and nitrates are providing nutrients that aid the proliferation of algae in the Sparkill. While the source of these substances is unknown, they frequently originate from urban runoff and sewage effluent.

Conductivity was slightly elevated for what is considered a good mixed fisheries level. The pH, alkalinity, water temperature, and dissolved oxygen readings all were within the parameters for a healthy stream.

The turbidity of 2.5 JTU is considered elevated for a healthy trout stream. Precipitation prior to testing can result in an elevated reading, but no rain was recorded for two days before the study. The appearance of the water was noted to be milky/gray, a common appearance of sewage effluents.

Unsurprisingly, the percent oxygen saturation level was low, suggesting that dissolved solids or bacterial decomposition are affecting the oxygen level of the testing segment. A healthy stream contains near 100% oxygen saturation at any given temperature (Hynes, 1970). Nieder's data reveals a mean oxygen saturation of 82.6% over the testing period.

Algae covers 100% of the substrate; note the milky/gray appearance of the water.

Total coliform levels were within NYS DEC standards at both collecting sites and E. coli was within EPA recommended levels at each testing site. However, the testing method did not follow NYS DEC collecting procedures of recording the geometric mean of five samples collected over a 30-day period. Because of the abundant algae growth and the proximity of sewage treatment plants to the kill, it would not be unreasonable to consider more intensive bacteriological study of the reach.

Water quality is moderately impacted by the Biological Assessment Profile (BAP) indicating poor water quality. Percent contribution of dominant family, percent composition of major groups, and the EPT/EPT + Chironomidae ratio also reflect poor water quality based on changes in the macroinvertebrate assemblage.

In January and July 2001, Bode calculated BAP scores of 5.08 and 5.5, respectively, at the same site location used in this study. Both scores are in the slightly impacted water quality rating; the delineating score between moderately and slightly impacted water qualities is 5.

Although seasonal variability and time of collection prohibit direct comparison of these samples to each other, the biological results of each survey for this testing reach indicate an adverse impact on the stream. Bode concluded that the Sparkill is considered "a medium priority for remediation," not only based on nonpoint source nutrient enrichment, but based on macroinvertebrate tissue sample testing for metals and polynuclear aromatic hydrocarbons (PAHs) noting that four metals "exceeded levels of concern" (Bode *et al.*, Jan. July 2001).

Additionally, a recent fish survey conducted on the Sparkill (Rosko and Johnson, 2002) found few top predators, no intolerant species, and many generalist and introduced species. Based on the eco-regional adjusted

Index of Biological Integrity (IBI) Rosko and Johnson concluded that the Sparkill is in very poor condition. The Sparkill has not been placed on the NYS DEC Impaired Waters 303(d) list.

CONCLUSIONS

1. The habitat assessment of the testing area is strongly suggestive of unhealthy conditions. Review of previous surveys of the reach indicates that it is a persistent problem.
2. Although chemical parameters were generally favorable, the low oxygen saturation of the stream and the levels of nitrates and phosphates indicate contaminants that could be detrimental to the health of, and intended use of, the stream.
3. Bacteriological testing was favorable. Our testing methods did not follow the DEC protocol of calculating the monthly geometric mean from a minimum of five samples, however.
4. The biological parameters indicate moderately impacted water quality and that pollutants are entering the water system and adversely affecting its biological integrity. Previous biological (macroinvertebrate and fish) surveys conducted on the Sparkill and on the same test segment confirms this finding.
5. The findings of this study indicate that there are impacts adversely affecting the test segment’s classification as a Class C stream. The impacts are limiting the kill’s intended uses, including its ability to sustain a healthy balanced population of native aquatic biota. Such impacts undoubtedly have the potential to adversely affect the surrounding community, also.

SUGGESTED SOLUTIONS

1. That the Sparkill be added to the NYS DEC Impaired Waters 303(d) list. Findings from this and previous studies indicate a persistent and significant impairment of the kill’s designated and intended use.
2. The initiation of educational programs for the community regarding the health of the kill and the potential impact on it due to residential and industrial practices.
3. Continued collection and assessment of data (including a complete set of coliforms) with additional site locations.

RATIONALE OF DATA COLLECTED AND METHODS

Physical

The *physical survey* is essential to a stream study because aquatic fauna often have specific habitat requirements independent of water composition, and alterations in these conditions affect the overall quality of a water body (Giller and Malmqvist, 1998). Additionally, the physical characteristics of a stream affect stream flow, volume of water within the channel, water temperature, and absorbed radiant energy from the sun.

Testing sites are evaluated for: stream size and gradient; surrounding land use; presence/absence of upstream dams; algal or weed growth; presence/absence of oily film, grease globules, or unusual odor or color; riffle size; substrate size; presence/absence of shelter for fish; flow pattern; channel alteration; stream bank cover and stability; disruption of the riparian bank cover; width of the riparian vegetation zone; and the presence of litter. Habitat condition was scored as excellent, good, fair, or poor. (See physical survey/habitat assessment data sheets for scoring parameters). Site photos were taken of the upstream area, downstream area, and banks of each testing site, and are included in the attached physical survey/habitat assessment sheets.

W*ater temperature* directly affects both the nature of aquatic fauna and species diversity; temperature tolerance is organism specific, and the reproductive cycle (including timing of insect emergence and annual productivity) will vary within different temperature ranges. Temperature can also affect organisms indirectly as a consequence of oxygen saturation levels. As water temperature rises, the metabolism of aquatic organisms increases, with an attendant increase in their oxygen requirements. At higher water temperatures, however, the oxygen carrying capacity of water decreases because of a diminished affinity of the water for oxygen.

Optimal water temperature ranges and lethal limits of water temperature vary among different organisms. The ratio of Plecoptera to Ephemeroptera (individuals and numbers of species) has been found to drop as the annual range of temperature increases (Hynes, 1970). The optimal temperature range for Brook trout is 11-16 ^{0} Celsius with an upper lethal limit of 24^0 Celsius (Hynes, 1970). NYS DEC does not have a water quality standard for water temperature.

Temperature was recorded by grab samples with a glass thermometer.

Turbidity, or the cloudiness of water, is caused by multiple factors such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton, and other microscopic organisms. Because the ability of trout to sight feed is restricted at turbidity levels above 50 Nephelometric Turbidity Units (NTU), salmonid displacement will occur above this level. A turbidity of less than 10 NTU is recommended for trout propagation (Watersheds, 1994).

A Lamotte turbidity column was used in this study, which visually measures turbidity in increments of 5 Jackson Turbidity Units (JTU). (The equivalency ratio is 1JTU/19NTU). The Lamotte method was obviously not sensitive enough to make determinations about the effect of turbidity on the sustainability of trout, since any reading greater than 0 would have exceeded 50 NTU.

NYS DEC does not have a numeric standard for turbidity.

Percent cobble embeddedness, the degree to which gravel-sized and larger particles are surrounded by sand-sized and smaller particles, is an indicator of a stream's ability to support trout survival and propagation. If deposition of sediment occurs in spawning areas, it can be detrimental to trout reproduction. Trout eggs require a well-oxygenated environment; the eggs are laid in permeable gravel beds with many open spaces to allow continuous bathing of the eggs with cool, oxygenated water. Sediment deposition destroys this environment by clogging these open spaces, leading to oxygen deprivation and buildup of metabolic waste. When cobble embeddedness reaches 50-60%, a stream loses its salmonid fry. Furthermore, although habitat quality is still considered fair for trout survival (though not propagation) at 50-75% embeddedness, changes in the bethnic macroinvertebrate fauna population, on which trout feed; begin to occur (Harvey, 1989).

Velocity was calculated at the time of macroinvertebrate collection because an optimal macroinvertebrate collection site has a velocity between 0.45 and 0.75 meter/second. Velocity was determined by averaging the time it takes a float to travel a marked distance midstream and near each bank, and dividing the distance of the course by the average time.

Chemical

Dissolved Oxygen (DO) level is a function of water turbulence, diffusion, and plant respiration. The EPA recommends that dissolved oxygen levels remain above 11 mg/l during embryonic and larval stages of salmonid production and above 8 mg/l during other life stages (EPA, 1987). The NYS DEC standard for dissolved oxygen for this class stream is 5 mg/L.

A significant drop in DO concentration can occur over a 24-hour period, particularly if a waterbody contains a large amount of plant growth. Oxygen is released into the water as a result of plant respiration during daylight; dense plant growth within a stream can therefore elevate the DO level significantly. At night plant respiration ceases and DO may drop to levels maintained by diffusion and turbulence. A pre-dawn DO level will, in this case, reflect the lowest DO concentration in a 24 hour period and thus provide important data on the overall health of the system.

DO was measured using the modified Winkler titration with microburet method.

It is also important to consider *percent oxygen saturation*, since dissolved oxygen levels vary inversely with water temperature. Percent saturation is the maximum level of dissolved oxygen that would be present in the water at a specific temperature in the absence of other influences, and is determined by calculating the ratio of measured dissolved oxygen to maximum dissolved oxygen for a given temperature. (The calculation is also standardized to altitude or barometric pressure.) Percent oxygen saturation falls when something other than temperature, such as dissolved solids or bacterial decomposition, affects oxygen levels.

A healthy stream contains near 100 percent oxygen saturation at any given temperature (Hynes, 1970). Trout are particularly sensitive to even a slight drop in oxygen saturation and will migrate away from streams when oxygen saturation falls. Similarly, certain macroinvertebrates are sensitive to varying saturation levels and because the ability of these organisms to migrate away from the changing conditions is limited a drop in saturation can be lethal. NYS DEC has not adopted percent oxygen saturation as a water quality standard. The assessment was included in this study because of our belief that it is vital to the complete evaluation of the health of a stream.

Conductivity is a measure of the ability of an electrical current to pass through a stream; it is dependent on both the concentration of dissolved electrolytes within the water and water temperature. When inorganic ions are dissolved in water, conductivity increases. Organic ions, such as phenols, oil, alcohol and sugar, can decrease conductivity (EPA, 1997). Warmer water is also more conductive and, therefore, conductivity is reported for a standardized water temperature of 25 degrees Celsius. Measurements are reported in microsiemens per centimeter (µs/cm).

In the United States, freshwater stream conductivity readings vary greatly from 50-1,500µs/cm. The conductivity of most streams remains relatively constant, however, unless an extraneous source of contamination is present. A failing septic system would raise conductivity because of its chloride, phosphate, and nitrate content, while an oil spill would lower conductivity.

Conductivity between 150 and 500µs/cm is considered a good mixed-fisheries range (EPA, 1997). A Corning pocket conductivity meter was used to measure conductivity. NYS DEC does not have a standard for conductivity.

The *pH* and *alkalinity* are measures of a stream's acidity and its buffering capacity, or ability to neutralize acidic influences and resist changes in pH. A desirable pH for salmonid is 6.5-8.5. An alkalinity of greater than 20 ppm helps to protect a stream from pH altering influences (such as acid rain). An Oakton pHtestr meter and the Lamotte alkalinity test kit direct reading titrator method were used to obtain pH and alkalinity, respectively. The NYS DEC standard for pH is 6.5-8.5. No standard has been established for alkalinity.

In most fresh water streams, *nitrates and phosphates* are in short supply and are therefore the nutrients that limit plant growth. Because of this, even small excess amounts of these substances can significantly impact a stream. Typically, natural levels of nitrate nitrogen (NO_3) are <1.0 mg/l. Phosphorus (P) levels of >0.05 mg/l indicate that impact is likely; at levels of >0.1 mg/l impact is certain. Increased levels of these nutrients often indicate that sewage, animal manure, fertilizer, and other types of contamination from commercial sites, residential homes, or farms are entering the system.

These nutrients affect aquatic organisms indirectly when elevated levels increase plant proliferation and, ultimately, decaying plant material in the stream. Bacteria that decompose this material require oxygen, depleting the dissolved oxygen. Excessive plant growth also physically changes the substrate on which macroinvertebrates live, altering the diversity of macroinvertebrate community on which trout feed.
It has been documented that nitrate levels are highest just before dawn due to plant inactivity (Stevenson et al., 1996). Plant uptake of nitrates during daylight due to plant metabolism can lower the levels in the water column; at night when plant activity ceases nitrate levels increase. Pre-dawn nitrate levels will therefore indicate maximum nitrate present in a 24-hour period.

Nitrates (NO_3) and Phosphorus (P) were measured using the Hach DR 890 colorimeter by chromotropic acid method and ascorbic acid reduction method, respectively. NYS DEC does not have a numeric standard for nitrates or phosphates.

Biological

Macroinvertebrates are collected by kick net and the specimens are preserved. Pollution-sensitive *macroinvertebrates*, a food source for trout, require similar chemical parameters as trout. The relative numbers of different macroinvertebrate groups indicate the overall health of an ecosystem. Perhaps more importantly, macroinvertebrate data demonstrate the effects of problems that may not be detected by chemical testing.

The NYS DEC Stream Biomonitoring Unit has utilized stream biological monitoring and water quality analysis since 1972 but the biological profiles and water quality assessments are not a part of the state's standards. They serve as a "decision threshold" to determine the need for further studies.

The Environmental Protection Agency recommends that states and tribes with biomonitoring experience adopt biological criteria into water quality standards to provide a quantitative assessment of a waterway's designated and supportive use. Currently only five states have done so; NY is not one of these states. Biological assessment was included in this study because of our belief that it is vital to the complete evaluation of the health of a stream.

The four family indices, or metrics, that are recommended by the NYS DEC Biomonitoring Unit to provide a biological profile and overall stream water quality assessment are as follows:

1. Family Richness: The total number of families found in the sample.
2. EPT richness: The number of families in the three most pollution sensitive orders – Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies)- that are present.
3. Biotic index: The product of the quantity of a particular macroinvertebrate found and its assigned biotic value (pollution tolerance value).
4. Percent model affinity, PMA: A comparison of the number of identified macroinvertebrates to a New York model "non-impacted" community, based on percent abundance in seven major groups.

A Biological Assessment Profile, as outlined by the DEC, is obtained from the four metrics by converting each metrics score to a 0-10 water quality scale and calculating their mean. The mean score identifies the water quality impact as: non-, slightly, moderately, or severely impacted. [For definitions of each category, see appendix VI]. The DEC surmises the ability of each of the above water qualities to support fish and their propagation, but a particular family or species of fish is not identified. This is significant because trout are sensitive to small amounts of pollutants and slight ecological changes, whereas bass or carp, having a higher tolerance to pollutants and ecological changes, are not.

It is prudent to remember that an index is a means to convey information about the status of a water body, but should not be used exclusive of its component metrics and data (EPA, 1999).

The HBRW Rapid Biological Assessment includes the above indices and:

1. Organism Density Per Sample: An estimate of the total number of individuals in the sample.
2. EPT/EPT + Chironomidae: A measure of the ratio of the intolerant EPT orders to the generally tolerant Diptera family Chironomidae.
3. Percent Contribution of Dominant Family: The percentage of the sample made up of the most abundant

family.

4. Percent Composition of Major Groups: The percent of the sample comprised of selected major groups.

[For complete definitions of indices see appendix VII]

Bacteriological

Coliforms are a group of bacteria that include fecal coliforms and other non-fecal bacteria that are widespread in the environment. They are found in the feces of both warm- and cold- blooded animals; they commonly live alongside numerous other pathogenic organisms present in fecal material, and serve as an indicator that these organisms might also be present in the water. Fecal material can pose a health risk, cause cloudy water with an unpleasant odor, and decrease dissolved oxygen as bacteria decompose the material.

Fecal coliforms are a subset of total coliforms; they are more specific to feces but not necessarily fecal in origin. They can originate from textile, pulp, and paper mill wastes (Behar, 1997). *E. Coli* is a fecal coliform specific to fecal material from humans and other warm-blooded animals. It is an indicator of health risk from water contact. (See appendix V for NYS DEC standards)

The Micrology Laboratories Coliscan Membrane method was used to determine total coliforms and E. coli.

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HBRW Tiers 2 & 3

Physical Survey / Habitat Assessment

Assess a 200 foot segment up & down stream from your sample site

Name(s) Hudson Basin River Watch Date 2/19/02 Time 1:00 pm

School/Group LDEO Stream Worshop Stream Sparkill Site 1

Weather: Today: Clear/Sunny Past 2 days Clear/Sunny **Temperature:** Air 4.2 ° C

UTM Coordinates: 18 590321 E 4542323 N Water 3.3 ° C

<table>
<tr><th colspan="9">Sampling Site Type (Check one from each row)</th></tr>
<tr><td>Stream Size</td><td colspan="3">Headwater Tributaries (<20 cfs)</td><td colspan="3">[✓ Creeks and Streams (20-150 cfs)]</td><td colspan="2">Larger Rivers (>150 cfs)</td></tr>
<tr><td>Gradient</td><td colspan="3">FAST (primarily riffle)</td><td colspan="3">[✓ VARIED (pools and riffles)]</td><td colspan="2">SLOW (low gradient)</td></tr>
<tr><td rowspan="2">Surrounding Land Use</td><td colspan="2">Forested</td><td colspan="2">Agricultural</td><td colspan="3">[✓ Residential]</td><td colspan="2">Urban</td></tr>
<tr><td>dense</td><td>sparse</td><td>pasture-land</td><td>crop-land</td><td>rural</td><td>[✓ village]</td><td>suburban</td><td>resident-ial</td><td>commercial/industrial</td></tr>
</table>

Upstream Dam: ☐ Yes ☑ No The stream is on average 4-5 meters wide and 0.35 meters deep

How far up stream: ___________

Compared to the height of the stream channel, the water level seems relatively: ☐ High ☑ Low ☐ Average

Turbidity is substantially greater than natural conditions: ☐ Yes ☑ No Describe___________________________

Algal or weed growth: 100 % of bottom covered

Oily film, grease globules, or unusual odor or color present ☐ Yes ☑ No

Describe:____

Average velocity: average time it takes to flow 3 meters:

a) 3 m / 5 = v1 0.6

b) 3 m / 9 = v2 0.33

AVERAGE: 0.47 **m/sec**

NOTE: 0.45 – 0.75 m/sec is optimal for macroinvertebrate collection sites.

Additional Notes:

Assessment Factors: *Check the box that best applies for each assessment factor.* *Site* 1 *Date* 2/19/02

Assessment Factor	Excellent	Good	Fair	Poor
Riffle Size	Well-developed riffle, as wide as stream & as long as 2x stream width;	Riffle as wide as stream but riffle length < 2x stream width	[✓ Riffle not as wide as stream and length < 2x stream width]	Riffles or run virtually nonexistent
Substrate Size	[✓ Cobble predominates; boulders, gravel common]	Cobble less abundant; boulders and gravel common	Gravel, boulders or bedrock prevalent; some cobble	Large boulders and bedrock or sand & silt prevalent; cobble lacking
Shelter for Fish	Snags, submerged logs, undercut banks, or other stable habitat are found in over 50% of the site	Snags, submerged logs, undercut banks, or other stable habitat are found in 30-50% of the site	[✓ Snags, submerged logs, undercut banks, or other stable habitat are found in 10-30% of the site]	Snags, submerged logs, undercut banks, or other stable habitat are found in < 10% of the site
Embeddedness (for tier 3, use *Stream Bottom Survey*)	Rocks in stream <25% embedded; very little sand, silt, or mud	[✓ Rocks 25-50% embedded; can easily turn over rocks]	Rocks 50-75% embedded and firmly stuck in sediments	Rocks >75% embedded; bottom mostly sand, silt, or mud
Flow Pattern (deep is > 2 ft)	[✓ All 4 patterns present: slow / deep, fast / shallow fast / deep, slow / shallow]	Only 3 of 4 flow patterns present	Only 2 of 4 flow patterns present	Dominated by 1 flow pattern
Channel Alteration	Stream straightening, dredging, artificial embankments, dams or bridge abutments absent or minimal; stream with meandering pattern	Some stream straightening, dredging, artificial embankments, or dams present, usually near bridge abutments; no recent channel alteration	[✓ Artificial embankments present to some extent on both banks; and 40-80% of stream site straightened, dredged, or otherwise altered]	Banks shored with gabion or cement; over 80% of the stream site straightened and disrupted
Stream bank cover and stability *	Banks stable; no evidence of erosion; bank covered by vegetation or rock	[✓ Moderately stable; small areas of erosion; most of bank covered by vegetation or rock]	Largely unstable; almost half of bank has areas of erosion or is not covered by vegetation or rock	Unstable, eroded; < half of bank covered by vegetation or rock, or rock slumping into creek
Disruption of riparian bank coverage* (land bordering stream bank)	Mature trees and vegetation; most growing naturally; no disturbance by forestry, grazing, or mowing	Trees, woody plants, soft green plants dominate; some disruption but not affecting full plant growth potential	[✓ Obvious disruption; patches of bare soil, cultivated fields or closely cropped vegetation are the norm]	Not much natural vegetation left or it has been removed to 3” or less in height
Width of riparian vegetation zone*	More than 35 yards wide; human activities have not impacted zone	Zone 12-35 yards wide; marginal impact from human activities	Zone 6-12 yards wide; impact from human activities evident	[✓ Zone <6 yards; lots of nearby human activities]
Litter	No litter (metal or plastic) in area	Very little litter; accidentally dropped	[✓ Litter fairly common; purposely dropped]	Lots of litter present; obviously dumped

*if the two banks are very different, assess the worse side

Given the assessment above, how would you rate your habitat? Fair

Describe how land uses / human activities may be impacting the stream:

Site Photos:

Site 1 Date 2/19/02

Include photos of the 200’ long segment of your river up and downstream from your stream site, recording specific physical and habitat features, including:

1. Your sampling sites—include where you collected water quality and macroinvertebrate samples and measured velocity and cross section area.
2. In-Stream Habitat – riffles, pools, runs, large woody debris, boulders, organic material, aquatic plants, overhanging vegetation, etc.
3. Streambanks – steep & gently sloping areas, naturally vegetated areas, bare, eroding, clear-cut, or mowed areas, artificially protected areas, etc.
4. Channel – wide & narrow areas, meanders, shaded & exposed areas, unnatural alterations, dams, culverts, etc.
5. Human Land Uses – roads, houses, driveways, parking lots, storm drain pipes, sewage pipes, factories, farms, livestock crossings, recreational use, logging, etc.

Physical Survey / Habitat Assessment

Site 1 Date 2/19/02

Note: 100% of the substrate is covered with a dense filamentous algae.

Chemical Data Reporting Sheet

Name(s) Hudson Basin River Watch School/Group LDEO Stream Worshop

Stream Sparkill Date(s) Sampled 2/19/02 Site 1

Today's weather conditions: ☑ clear ☐ cloudy ☐ light rain ☐ heavy rain ☐ other_____ air temp 4.2 °C water temp 3.3 °C

In the past 24 hours, there was: ☐ light rain ☐ heavy rain ☐ snow ☑ other: Clear/Sunny

Flow (indicate fast reading here and calculated reading below): ☐ high ☐ medium ☑ low

	Replicates 1		Replicates 2		Average	Tier	Notes	Check Method Used
Lab Duplicates	*1*	*2*	*1*	*2*				
pH	7.30				7.3			pH paper (1-14, by 1), color comparator, [✓ pocket meter] (1-14, by 0.1), Other:
Alkalinity (mg/l)	145				145			*Sulfuric Acid Titration*, [✓ LaMotte microburet], *Sulfuric Acid Double Endpoint Titration*, HACH digital titrator
Chloride (mg/l)	---				---			*Silver Nitrate Titration* LaMotte Microburet, HACH drop count:
Turbidity	2.5				2.5			Nephelometer, [✓ Other]: JTU's- Lamotte Turbidity Column
Conductivity (uS/cm)	570				570			[✓ Meter] or other:
Nitrate-Nitrogen as: NO_3* ☑ mg/l N (check one)	1.4				1.4			*Zinc Reduction*; LaMotte color comparator. *Cadmium Reduction* HACH colorwheel or LaMotte color comparator, HACH DR700 or 800 [✓ colorimeter] or spectrophotometer. Standard curve? yes [✓ no]
Ortho-Phosphate as PO_4 P** ☑ mg/l (check one)	0.073				0.073			*Ascorbic Acid Reduction*, HACH color wheel (0-5 by 0.5 ppm), LaMotte color comparitor with axial reader, HACH DR700 or 800 series [✓ colorimeter] or spectrophotometer. Standard curve? yes [✓ no]

Dissolved Oxygen (mg/l)	10.6				10.6			*Modified Winkler Titration*: [✓ LaMotte micro-buret], HACH drop count, HACH digital titrator
Dissolved Oxygen (% Saturation)	81				81			
Other: add units)								

Describe your QaQc procedures here: HBRW RWAP

NOTE: *Nitrate-Nitrogen: report as NO_3-N (NO_3-N = NO_3/4.4) **Orthophosphate: report as P (P = PO_4/3)

Appendix III

HBRW Family Level Benthic Macroinvertebrate Data Analysis Sheet

Site#: 1 Just below Valintine St. bridge

Date Sampled: Feb. 20/2002

Date of Lab Work Feb. 27/2002

River/Stream/County: Sparkill

Name(s) J. Kelly Nolan

	1	2	3	Mean
# Squares Picked	1			1
Total # Squares in Tray Grid				12
Replicate #	1	2	3	

Replicate #	1	2	3

I	II	III	IV	V	VI	VII	VIII
Families in Major Groups	T (1)	D (2)	D	D	$\bar{D}$	T x $\bar{D}$	% (3)
EPHEMEROPTERA (E)							
Baetidae	6	0			0	0	0
Baetiscidae	4	0			0	0	0
Caenidae	6	0			0	0	0
Ephemerellidae	2	0			0	0	0
Ephemeridae	4	0			0	0	0
Heptageniidae	3	0			0	0	0
Leptophleblidae	4	0			0	0	0
Metretopodidae	2	0			0	0	0
Oligoneuriidae	2	0			0	0	0
Polymitarcylidae	2	0			0	0	0
Potomanthidae	4	0			0	0	0
Siphlonuridae	7	0			0	0	0
Tricorythldae	4	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal E					0	0	0
PLECOPTERA (P)							
Capniidae	3	0			0	0	0
Chloroperlidae	0	0			0	0	0
Leuctridae	0	0			0	0	0
Nemouridae	2	0			0	0	0
Peltoperlidae	0	0			0	0	0
Perlidae	3	0			0	0	0
Perlodidae	2	0			0	0	0
Pteronarcyidae	0	0			0	0	0
Taeniopterygidae	2	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal P					0	0	0
MEGALOPTERA (M)							
Corydalidae	4	0			0	0	0
Sialidae	4	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal M					0	0	0
LEPIDOPTERA (L)							
Pyralidae	5	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal L					0	0	0

I	II	III	IV	V	VI	VII	VIII
Families in Major Groups	T	D	D	D	$\bar{D}$	T x $\bar{D}$	%
TRICHOPTERA (T)							
Brachycentridae	2	0			0	0	0
Glossosomatidae	1	0			0	0	0
Helicopsychidae	3	0			0	0	0
Hydropsychidae	5	6			6	30	0.06
Hydroptilidae	6	0			0	0	0
Lepidostomatidae	1	0			0	0	0
Leptoceridae	4	0			0	0	0
Limnephilidae	4	0			0	0	0
Molannidae	6	0			0	0	0
Odontoceridae	0	0			0	0	0
Philopotamidae	3	0			0	0	0
Phryganeidae	4	0			0	0	0
Polycentropodidae	6	0			0	0	0
Psychomyiidae	2	0			0	0	0
Rhyacophilidae	1	0			0	0	0
Sericostomatidae	3	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal T					6	30	0.06
DIPTERA (D)							
Athericidae	4	0			0	0	0
Blephariceridae	0	0			0	0	0
Ceratopogonidae	6	0			0	0	0
Chironomidae	6	57			57	342	0.57
Tipulidae	4	4			4	16	0.04
Empididae	6	0			0	0	0
Simuliidae	5	5			5	25	0.05
Tabanidae	5	0			0	0	0
		0			0	0	0
		0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal D					66	383	0.66
ISOPODA (I)							
Asellidae	8	1			1	8	0.01
		0			0	0	0
Other		0			0	0	0
Subtotal I					1	8	0.01

Appendix III

COLEOPTERA (C)							
Dryopidae	5	0			0	0	0
Elmidae	5	13			13	65	0.13
Gyrinidae	4	0			0	0	0
Haliplidae	5	0			0	0	0
Psephenidae	4	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal C					13	65	0.13
ODONATA (O)							
Aeshnidae	5	0			0	0	0
Calopterygidae	6	0			0	0	0
Coenagrionidae	8	0			0	0	0
Cordulegastridae	3	0			0	0	0
Corduliidae	2	0			0	0	0
Gomphidae	4	0			0	0	0
Lestidae	9	0			0	0	0
Libellulidae	2	0			0	0	0
Macromiidae	2	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal O					0	0	0
AMPHIPODA (A)							
Crangonyctidae	6	0			0	0	0
Gammaridae	6	5			5	30	0.05
Talitridae	8	0			0	0	0
		0			0	0	0
Other		0			0	0	0
Subtotal A					5	30	0.05

DECAPODA (I)							
Cambaridae	6	0			0	0	0
Astacidae	6	0			0	0	0
Other		0			0	0	0
Subtotal I					0	0	0
OTHER							
Oligochaeta	9	3			3	27	0.03
Hirudinea	7	0			0	0	0
Gastropoda	7	0			0	0	0
Pelecypoda	6	0			0	0	0
Turbellaria	6	0			0	0	0
Nemertea	8	6			6	48	0.06
Other		0			0	0	0
Subtotal Other					9	75	0.09

TOTALS	100	591	1

Organism Density/Sample Unit	1200
EPT Richness	1
Total Family Richness	9
EPT/EPT+Chironomidae Ratio	0.10
Biotic Index	5.91
% Contribution of Dominant Family	57%
% Model Affinity	49%

% COMPOSITION OF MAJOR GROUPS		
EPHEMEROPTERA		0%
PLECOPTERA		0%
TRICHOPTERA		6%
CHIRONOMIDAE		57%
OTHER DIPTERA		9%
COLEOPTERA		13%
ODONATA		0%
MEGALOPTERA		0%
LEPIDOPTERA		0%
AMPHIPODA		5%
ISOPODA		1%
OLIGOCHAETA		3%
GASTROPODA		0%
PELECYPODA		0%
OTHER		6%

EPT RICHNESS = RE+RP+RT

# Ephemeroptera Families	0
# Plecoptera Families	0
# Trichoptera Families	1
EPT Richness (Total)	1

Codes:

(1) T = Hilsenhoff pollution tolerance- NYS DEC adjusted values

(2) D = Density

(3) % = percent composition

MICROLOGY LABORATORIES COLISCAN MEMBRANE FILTRATION

Coliscan media incorporate a patented combination of color-producing chemicals and nutrients that mark coliforms and *E. coli* in differing colors for easy identification and isolation. This means that a test sample of water or other material may be added to the medium, and coliform bacteria will grow as pink-magenta colonies while *E. coli* will grow as purple-blue colonies. Other bacterial types will generally grow as non-colored colonies.

Incubated coliforms using 10 cc sub-sample from a 100 cc sample

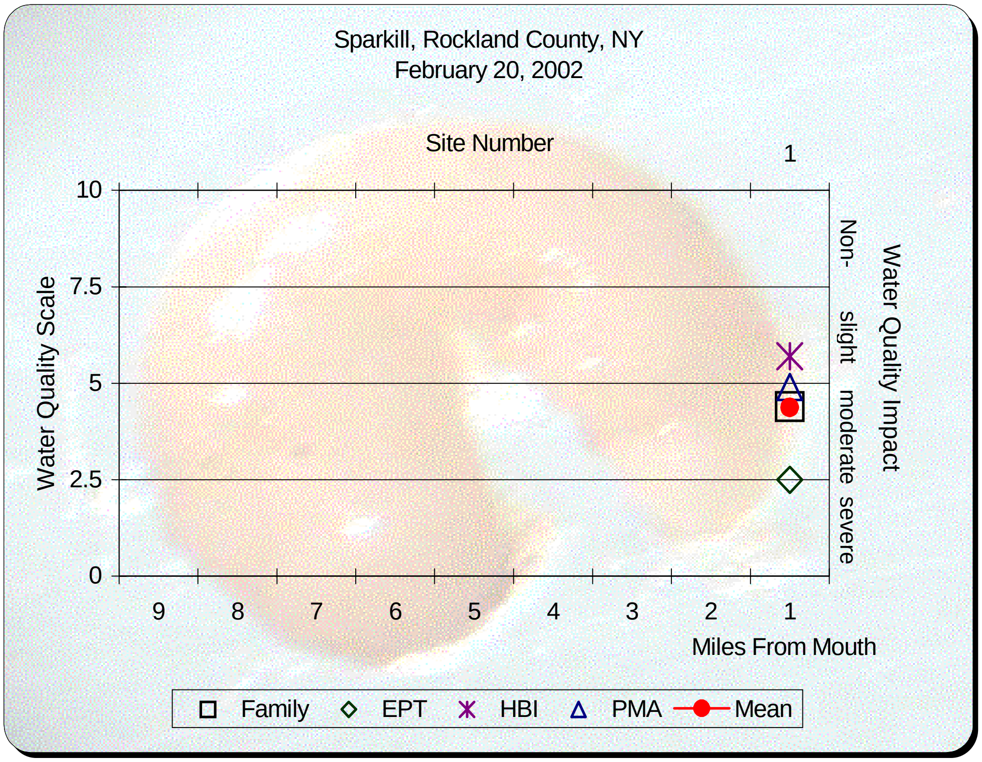
Plate counts are then multiplied by 10 for total colonies/100ml

Sparkill Coliform/100 ml			
Site	**E-Coli**	**Total Coliforms**	**Other**
1	0	0	numerous
2	70	1,220	numerous

Biological Assessment Profile

For explanation see the Biological section in

RATIONALE OF DATA COLLECTED AND METHODS



NEW YORK STATE SURFACE WATER QUALITY STANDARDS CLASS C WATERS

According to the DEC Water Quality Regulation manual, the best usages of Class C waters are for fishing. Furthermore, the waters shall be suitable for fish propagation and survival and the quality shall be suitable for primary (where body may become submerged in water) and secondary (where contact with the water is minimal) contact recreation.

Parameter	Class	NYS DEC Standard
PH	C, C (T)	Shall not be less than 6.5 nor more than 8.5
Dissolved Oxygen	C, C (T)	For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/L from other than natural conditions. For trout waters, the minimum daily average shall not be less than 6.0 mg/L, and at no time shall the concentration be less than 5.0 mg/L. For nontrout waters, the minimum daily average shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L.
Temperature	C, C (T)	No standard
Total phosphorus	C, C (T)	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Nitrogen	C, C (T)	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Alkalinity	C, C (T)	No standard
Total Coliforms (number per 100 ml)	C, C (T)	The monthly median value and more than 20 percent of the samples, from a minimum of five examinations, shall not exceed 2,400 and 5,000, respectively
Fecal Coliforms (number per 100 ml)	C, C (T)	The monthly geometric mean, from a minimum of five examinations, shall not exceed 200.
E. Coli	C, C(T)	No standard
Turbidity	C, C (T)	No increase that will cause a substantial visible contrast to natural conditions

This testing section of the Sparkill has been classified by the New York State Department of Environmental Conservation (NYS DEC) as Class C waters, with water quality standards of C.

NYS DEC DIVISION OF WATER RESOURCES

Item No.	Waters Index Number	Name	Description	Map Ref. No.	Class	Standards
2	**H-13 portion as described including P 24**	Sparkill Creek [Ferdon Pond]	From dam forming Ferdon Mill Pond 24, to Valentine Avenue, Sparkill	2	C	C

NYS DEC FAMILY-LEVEL MACROINVERTEBRATE INDICES

1. *Family richness:* This is the total number of macroinvertebrate families found in a riffle kick sample. Expected ranges for 100-organism sub samples of kick samples in most streams in New York State are: greater than 12, non-impacted; 9-12, slightly impacted; 6-8, moderately impacted; less than 6, severely impacted.
2. *Family EPT richness:* EPT denotes the orders of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera). These are considered to be mostly clean-water organisms, and their presence generally is correlated with good water quality (Lenat, 1987). The number of EPT families found in a 100-organism sub sample is used for this index. Expected ranges from most streams in New York State are: greater than 7, non-impacted; 4-7, slightly impacted; 1-3, moderately impacted; and 0, severely impacted.
3. *Family Biotic Index:* The family-level Hilsenhoff Biotic Index is a measure of the tolerance of the organisms in the sample to organic pollution (sewage inputs, animal wastes) and low dissolved oxygen levels. It is calculated by multiplying the number of individuals of each family by its assigned tolerance value, summing these products, and dividing by the total number of individuals. On a 0-10 scale, tolerance values range from intolerant (0) to tolerant (10). Values are listed in Hilsenhoff (1988); additional values for non-arthropods are assigned by the NYS Stream Biomonitoring Unit. The most recent values are listed in the Quality Assurance document (Bode et al., 1996). 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:* This is a measure of similarity to a model non-impacted community based on percent abundance in 7 major groups (Novak and Bode, 1992). Percentage similarity is used to measure similarity to a community of 40% Ephemeroptera, 5% Plecoptera, 10% Trichoptera, 10% Coleoptera, 20% Chironomidae, 5% Oligochaeta, and 10% Other. Ranges for the levels of impact are: >64, non-impacted; 50-64, slightly impacted; 35-49, moderately impacted; and <35, severely impacted.

Non-impacted: Indices reflect very good water quality. The macroinvertebrate community is diverse, usually with at least 12 families in riffle habitats. Mayflies, stoneflies, and caddisflies are well represented; EPT family richness is greater than 7. The biotic index value is 4.50 or less. Percent model affinity is greater than 64. Water quality should not be limiting to fish survival or propagation. This level of water quality includes both pristine habitats and those receiving discharges which minimally alter the biota.

Slightly impacted: Indices reflect good water quality. The macroinvertebrate community is slightly but significantly altered from the pristine state. Family richness usually is 9-12. Mayflies and stoneflies may be restricted, with EPT values of 4-7. The biotic index value is 4.51-6.50. Percent model affinity is 50-64. Water quality is usually not limiting to fish survival, but may be limiting to fish propagation.

Moderately impacted: Indices reflect poor water quality. The macroinvertebrate community is altered to a large degree from the pristine state. Family richness usually is 6-8. Mayflies and stoneflies are rare or absent, and caddisflies are often restricted; EPT richness is 1-3. The biotic index value is 6.51-8.50. The percent model affinity value is 35-49. Water quality often is limiting to fish propagation, but usually not to fish survival.

Severely impacted: Indices reflect very poor water quality. The macroinvertebrate community is limited to a few tolerant Families. Family richness is less than 6. Mayflies, stoneflies, and caddisflies are rare or absent; EPT richness is 0. The biotic index value is greater than 8.51. Percent model affinity is less than 35. The dominant species are almost all tolerant, and are usually midges and worms. Often 1-2 species are very abundant. Water quality is often limiting to both fish propagation and fish survival.

How to Summarize and Interpret Benthic Macroinvertebrate and Habitat Data

Geoff Dates and Jack Byrne: *Living Waters, Using Benthic Macroinvertebrates and Habit to Assess Your River's Health*. River Watch Network. 1997.
The following is modified to the NYS DEC Stream Biomonitoring Unit Indices

Organism Density/Per Sample:
An estimate of the total number of individuals in the sample based on the number of organisms picked from a certain number of squares.
It is calculated as follows:

1. Calculate the average density for each major group (density for each replicate divided by the number of replicates) and sum them to find the total average # of organisms picked.
2. Divide the number of squares picked by the number of squares in the grid to find the percentage of squares picked (e.g. 3 ¸ 12 = 0.25).
3. Divide the total average # of organisms picked by the percentage of squares picked. The result is the organism's density per sample.

Density varies considerably form stream to stream. It's best to compare results with a specific reference site.
In general, however, density will increase with the addition of organic matter (which happens naturally in a river system as one moves downstream) and/or improvements in habitat conditions. Density will decrease with siltation, low pH, and toxic substances.

EPT Family Richness:
The number of mayfly (E), stonefly (P), and caddisfly (T) families in the sample. This is an actual count of the number of families in the sample.
EPT family richness is calculated by summing the number of mayfly, stonefly, and caddisfly families in which you found and entered at least one organism on the work sheet (including the taxa in the "Other" section).

The orders Ephemeroptera (mayflies), Plecoptera (stonefly), and Trichoptera (caddisflies) are known to contain many taxa, which are sensitive to water quality changes. Generally, the more EPT families, the better the water quality or the better the habitat. However, some pristine headwater streams may be naturally low in richness, due to a relative lack of food (quantity and different types) and generally lower abundance of organisms. In these areas, an increase in richness may mean pollution from organic material (from failing septic systems, for example).

For most sites, there should be more than 10 – 12 estimated or identified families.

However, the newly revised expected EPT Family richness index for a 100-organism sub sample in New York State provided by the NYS DEC Stream Biomonitoring Unit ranges are:

- Greater than 7, non-impacted
- 4-7, slightly impacted
- 1-3, moderately impacted
- 0, severely impacted

Total Taxa Richness:
The number of macroinvertebrate families in the sample. It is an actual count of the number of families in the sample.

Total family richness is calculated by summing the number of families in which you found and entered at least one organism on the work sheet (including the taxa in the "Other" section).

Total family richness is a rough measure of the diversity of the macroinvertebrate community. It responds in much the same way as EPT Richness.

Expected ranges for 100-organism sub samples of kick samples in most streams in New York State are:

- greater than 12, non-impacted;
- 9-12, slightly impacted;
- 6-8, moderately impacted;
- less than 6, severely impacted.

EPT/EPT + Chironomidae:
EPT/EPT + Chironomidae is a measure of the ratio of the abundance of the intolerant EPT orders to the generally tolerant Diptera family Chironomidae. EPT/EPT + C is calculated by dividing the number (abundance) of animals from the orders Ephemeroptera, Trichoptera and Plecoptera, by the above plus the number of animals of the order Chironomidae in the sample.

The results now lie between 0 and 1. The closer to 1, the better:
- >0.65 = Reference condition
- >0.55 = Minimal change from reference condition
- >0.45 = Moderate change from reference condition

Biotic Index:
This analysis was developed by Hilsenhoff and summarizes the various pollution tolerances of the families that make up the aquatic insect community with a single value. Each family is assigned a pollution tolerance value from 0 – 10, with 0 being intolerant and 10 being the most tolerant.
The index is calculated as follows:
1. Determine the pollution tolerance values for each family.
2. For each Family, calculate the following: Average density for each Family X the Pollution Tolerance Value for Each Family.
3. Add the results for all the families and divide this by the Total average density (# of organisms picked). The result is the biotic index.

The NYS DEC Stream Biomonitoring Unit family Biotic Index is:
- 0 – 4.50, non-impacted
- 4.51 –6.50, slightly impacted
- 6.51 – 8.50, moderately impacted
- 8.51 - 10.0, severely impacted

The Biotic Index increases with pollution from sources of organic material like sewage or animal manure.

Percent Contribution of Dominant Family:
The percentage of the sample made up of the most abundant family.
It is calculated as follows:
1. Identify the family in the sample with the most organisms picked (average density)
2. Divide the # of organisms picked in this family by the total number picked in the sample. This is the percent contribution of the dominant family.

A sample dominated (>50%) by one family may indicate an environmental impact.

Percent Model Affinity:
This is a measure of the similarity of the Percent Composition of Selected Major Groups of your sample to that of a model “non-impacted” community. The Model Community for NYS is as follows:
- 40% Ephemeroptera (Mayflies)
- 5% Plecoptera (Stoneflies)
- 10% Trichoptera (Caddisflies)
- 10% Coleoptera (Beetles)

- 10% Chironomidae (Midges)
- 5% Oligochaeta (Worms)
- 10% other

The Percent Model Affinity is calculated as follows:

1. Determine the percent of the sample in each of the seven major groups (see percent composition above).
2. For each group, find the absolute difference (subtract the lower percent from the higher percent) between the model and the sample.
3. Sum these absolute differences.
4. Multiply the sum by 0.5 and subtract this number from 100. This is the percent Model Affinity.

Ranges for the levels of impact are:

- >64, non-impacted
- 50-64, slightly impacted
- 35-49, moderately impacted
- <35, severely impacted

Percent Composition of Major Groups:
The percent of the sample in selected major groups. These groups are Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), Coleoptera (beetles), Chironomidae (midges), Oligochaeta (worms) and other.

It is calculated as follows:

1. Calculate the average density for each of the families (density for each replicate divided by the number of replicates) and sum them to find the total average # of organisms picked
2. Subtotal these densities for each major group.
3. Add the average densities for the major groups other than mayflies, stoneflies, caddisflies, beetles, midges and worms to find the average density for the "Other" group. Note: Chironomidae is not included in the "Other" group—though it's a family within the Order Diptera, it's a group in and of itself for this metric.
4. Apply the following formula to calculate the percent composition for each major group:

$$\frac{\text{Average Density for Each Major Group}}{\text{Total Average \# of Organisms Picked}}$$

In general, the mayflies, stoneflies, and caddisflies should be well represented. If any of these groups are absent, it indicates that there may be a problem. As a group, stoneflies are the most sensitive to pollution from sewage and other organic material. They usually make up a relatively small percentage of the sample (in NYS 5%) and are usually the first to disappear from the stream. If they are not present, stream quality may be moderately degraded. Mayflies contain many taxa that are sensitive to pollution. They make up a significant percent of the sample (in NYS 40%) and are usually the next to disappear. If neither mayflies nor stoneflies are present, the stream may be moderately to seriously degraded. Caddisflies contain many taxa that are sensitive to pollution, but also one common taxon (certain genera within the family Hydropsychidae), which is tolerant to pollution. It is very rare to find a sample with no caddisflies – usually the Hydropsychidae caddisflies will be present even in seriously degraded streams. If the sample is dominated (>50%) by worms or midges, the stream may be seriously degraded.