A MODIFIED RAPID BIOASSESSMENT OF THE VLOMAN KILL, ALBANY COUNTY, NY

Conducted August 6, 2001 by

The Five Rivers Environmental Education Center Living Environment Institute

and

The Hudson Basin River Watch Rapid Bioassessment Team

<u>Vloman Kill, Albany County, NY</u>

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BACKGROUND

In August, 2001, Hudson Basin River Watch and the New York State Department of Environmental Conservation (NYS DEC) Five Rivers Environmental Education Center conducted a modified rapid biological assessment on the Vloman Kill in Albany County, NY. The Vloman Kill is a meandering class C, C(T) stream [see appendage I] that travels though the Five Rivers Environmental Education Center (FREEC), consisting of wooded and old-field succession growth.

Physical site assessment, biological monitoring and chemical analysis were performed at one site.

This report provides the chemical, physical, and biological data collected at the designated site, an assessment of the biological health of the testing reach and suggestions for future monitoring.

Brook trout habitat requirements were used as a standard in this study, in part, because the stream is designated as a trout stream, but also, because the Federal Clean Water Act is designed to protect indigenous aquatic life and Brook trout are the only native stream-dwelling trout in Northeastern America.

The participants of the FREEC Living Environment Institute and the Hudson Basin River Watch Rapid Bioassessment Team planned and implemented the study.

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.

PHYSICAL ASSESSMENT

[Physical data appendage II]

A *physical survey* of the testing reach included: evaluation of the 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 any presence or absence of litter. Site photos were taken of the upstream area, downstream area, and banks of each testing site.

Brook Trout	Upper limit (°C)	Optimum Range (°C)
adult	24	11 –16

Water temperature was recorded by grab sample. The temperature recording was above both the optimum range for trout and the upper limit for viability, with a recording of 24.4 degrees Celsius. Data is not available on how long the temperature remained outside the upper limit. Further temperature recordings, perhaps using a temperature logger, are needed to document daily fluctuations.

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 waters.[1] 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 turbidity recorded was 5 JTU at the site. 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.

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 at this level.[2]

Percent Cobble Embeddedness	Habitat Quality
< 25%	Excellent Conditions
25—50%	Good Conditions
50—75%	Fair Conditions
> 75 %	Poor Conditions

Cobble embeddedness of 25—50% was found at the site.

Velocity was calculated by averaging the time it takes a float to travel a marked distance and dividing the distance of the course by the average time.

Stream velocity of 0.095 cubic meter/sec was recorded at the site. This is below the optimal (0.15 – 0.75 cubic meter/second) parameter for bethnic macroinvertebrate collecting sites.

CHEMICAL ASSESSMENT

[Chemical data appendage III]

Dissolved oxygen was measured using the modified Winkler titration with microburet method at the site. 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.[3] The NYS DEC standard for dissolved oxygen for this class stream is 6 mg/L. Dissolved oxygen levels were 7.8 ppm at the site.

It is also important to consider percent oxygen saturation, however, 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. Percent oxygen saturation falls when something other than temperature, such as dissolved solids or bacterial decomposition, affects oxygen levels.

Dissolved Oxygen ppm and Percent Oxygen Saturation		
8/6/01	**DO ppm**	**% Sat.**
Site	**7.8**	**92**

A healthy trout stream contains near 100 percent oxygen saturation at any given temperature.[4] Trout are particularly sensitive to low levels of oxygen saturation and will migrate away from streams with such unfavorable conditions.

A 92% dissolved oxygen saturation level was recorded at the site.

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. 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.[5]

Using the Corning pocket conductivity meter, a reading of 511µs/cm was recorded at the site.

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 influences such as acid rain.

Using the Oakton pHtestr meter and the Lamotte alkalinity test kit direct reading titrator method, acceptable pH and alkalinity readings were recorded at the testing site.

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 ppm. Phosphorus (P) levels of >0.05 ppm indicate that impact is likely; at levels of >0.1 ppm 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 trout 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.

Nitrates (NO_3) and orthophosphates (PO_4) were measured using the Hach DR 890 colorimeter by chromotropic acid method and ascorbic acid reduction method, respectively. Orthophosphates were recorded as PO_4; the phosphorus level was obtained by dividing this value by 3.

Acceptable readings of NO_3 and P were recorded at the site.

BIOLOGICAL ASSESSMENT

[Biological data appendages IV]

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 no longer detectable by chemical testing. [See appendage V]

The NYS DEC Stream Biomonitoring Unit has utilized stream biological monitoring and water quality analysis since 1972. Unfortunately, the unit's biological profiles and water quality assessments are used only in an unofficial capacity by the NYS DEC Division of Water. They are not a part of the state's standards, but 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 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.

Two replicates of *Macroinvertebrates* were collected from the site by kick net. A live 100-macroinvertebrate sub-sample from each replicate was classified to the level of order, sorted to family by morphology and then averaged. The macroinvertebrates were retuned to the stream and biological metrics were then determined for the averaged replicate.

The four family indices, or metrics, that are calculated 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), Tricoptera (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.

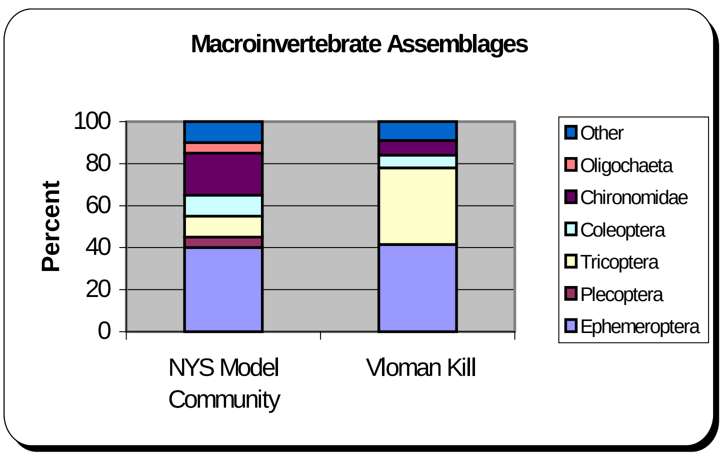
The HBRW Modified Rapid Biological Assessment includes the NYS DEC Biomonitoring Unit's PMA, EPT, and Family Richness indices and:

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 Composition of Major Groups: The percent of the sample comprised of selected major groups.
4. Major Group Biotic Index: The coarse estimate of the pollution tolerance of the community based on estimated pollution tolerances of the major groups that make up the aquatic insect community.

Macroinvertebrate Index Scores	Site 1
Organism Density/Sample Unit	133
EPT Richness	4
Total Taxa Richness	11
EPT/EPT + Chironomidae Ratio	0.92
Major Group Biotic Index	3.02
% Model Affinity	72%

[For summaries, calculation methods, water quality value ranges, and interpretation methods of indices see appendages VI, VII]

Total taxa richness and the EPT index scored water quality as slightly impacted, although the EPT index was at the low end of the category. The EPT/EPT + Chironomidae and Major Group Biotic Index scored water quality as non-impacted. The Percent Model Affinity also rated water quality as non-impacted despite a noticeable change in the macroinvertebrate assemblages when compared to the NYS macroinvertebrate model community (see chart at left). Evaluation of the Percent Composition of Major Groups suggests moderately impacted water quality based on the absence of Plecoptera (from either replicate sample or sub-samples) and the abundance of Trichoptera (37%) of which 32% are known to be from the families Hydropsychidae and Philopotamidae, both know as organic filter feeders.



SUMMARY OF STUDY RESULTS

Physical Parameters

1. The physical survey indicated that the stream reach may not be conducive to trout.
2. Algae growth on the substrate was significant.
3. Water temperature exceeded the optimal and upper limit range for trout viability.
4. Turbidity data obtained was insufficient for trout habitat interpretation.
5. Cobble embeddedness fell within the desired parameters for trout habitat.

Chemical Parameters

1. The dissolved oxygen level was above the NYS standard however, dissolved oxygen fell below the EPA recommendation for trout.
2. The percent oxygen saturation level appeared to be adequate for trout.

3. Conductivity measurement was slightly elevated for what is considered a good mixed-fisheries range.
4. Alkalinity, pH, phosphorous, and nitrate levels were all found to be adequate.

Biological Parameters

1. Biological indexes ranged from non-impacted to moderately impacted water quality.

OVERALL CONCLUSIONS

1. Water temperature indicates the test segment may not be conducive to trout survival.
2. Abundant algae growth on the substrate may be alerting the macroinvertebrate community.
3. Chemical data indicates that the test segment may be conducive to supporting trout, however, a definitive conclusion may not be drawn without further longitudinal testing.
4. Biological data indicates an altered macroinvertebrate community.

SUGGESTIONS

In order to confirm and expand upon some of our data, as well as to monitor the health of the kill, we recommend further collection and assessment of data on a longitudinal basis. In addition to this, we feel that community education to heighten awareness of the impacts that residential and agricultural practices have upon the kill is mandatory.

The Five Rivers Environmental Educational Center is in a key position to initiate and oversee the establishment of a community watershed committee or association that could provide:

- Educational and training seminars for local community members and organizations
- Continued and expanded volunteer monitoring

Citations:

[1] Watersheds. Water, Soil, and Hydro-Environmental Decision Support System. 1994. Aquatic Life: Rivers and Streams, Salmonidae. http://h2osparc.wq.ncsu.edu/index.html

[2] Harvey, G.W. 1989. Technical Review of Sediment Criteria, for Consideration for Inclusion in Idaho Water Quality Standards. Idaho Dept. of Health and Welfare, Water Quality Bureau, Boise, ID.

[3] USEPA. U.S. Environmental Protection Agency. 1987. Quality Criteria for Water. EPA Publication 440/5-86- 001. U.S. Gov. Prin. Office, Washington D.C.

[4] Hynes, H.B.N., *The Biology of Polluted Waters*. Toronto Canada. University of Toronto Press. 1974.

[5] Environmental Protection Agency. *Volunteer Stream Monitoring*: A Methods Manual. Washington, D.C.: Office of Wetlands, Oceans and Watersheds, Assessment and Watershed Protection Division (4503F). November 1997.

Bibliography:

Behar, Sharon. *Testing the Waters: Chemical and Physical Vital Signs of a River*. Dubuque, Iowa: Kendall/Hunt, 1997.

Caduto, Michael J. *Pond and Brook: A Guide to Nature in Freshwater Environments*. Hanover, New Hampshire: University Press of New England, 1990.

Dates, Geoff and Byrne, Jack. *Living Waters, Using Benthic Macroinvertebrates and Habitat to Assess You River's Health*. River Watch Network. 1997.

Elder, Don and Killam, Gayle and Koberstein, Paul. *The Clean Water Act: An Owner's Manual*. Portland, Oregon. River Network. 1999.

Giller, Paul S. and Malmqvist, Bjorn. *The Biology of Streams and Rivers*. Oxford, New York. Oxford University Press. 1998.

Hauer, Richard F. and Lamberti, Gary A. *Methods in Stream Ecology*. New York, New York. Academic Press. 1996.

Hunter, Christopher J. *Better Trout Habitat, A Guide to Stream Restoration and Management*. Washington, D.C. Island Press. 1991.

Hynes, H.B.N., *The Ecology of Running Waters*. Toronto Canada. University of Toronto Press. 1970.

Karr, R. James and Chu, Ellen W. *Restoring Life in Running Waters, Better Biological Monitoring*. Washington, D.C. Island Press. 1999.

Lepopold, Luna B. *Water, Rivers and Creeks*. Sausalito, California. University Science Books. 1997.

McCafferty, Patrick W. *Aquatic Entomology, The Fishermen's and Ecologists' Illustrated Guide to Insects and Their Relatives*. Sudbury, Massachusetts. Jones and Bartlett Publishers. 1981.

New York State Department of Environmental Conservation, Division of Water Quality. *Water Quality Regulations Surface Water and Groundwater Classifications and Standards*. Effective January 9, 1994. Albany, NY.

Peckarsky, Barbara L. et al. *Freshwater Macroinvertebrates of Northeastern North America*. Ithaca, NY. Cornell University Press. 1990.

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.
Turbidity	C, C (T)	No increase that will cause a substantial visible contrast to natural conditions.

NYS DEC DIVISION OF WATER RESOURCES						
Item No.	**Waters Index Number**	**Name**	**Description**	**Map Ref. No.**	**Class**	**Standards**
582	**H-217 portion as described**	Vloman Kill or Baker Creek	From mouth to trib. 9	K-24se	C	C
583	**H-217 portion including P 226, P 226c, P 226e**	Vloman Kill or Baker Creek	From trib. 9 to source	K-24se	C	C(T)

HBRW Tiers 2 & 3

Physical Survey / Habitat Assessment

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

Name(s) HBRW Rapid Bioassessment Team Date 8/6/01 Time am

School/Group FREEC/LEI Stream Vloman Kill Site 1

Weather: Today: Humid, Clear Past 2 days Humid, Clear **Temperature:** Air 32 ° C

UTM Coordinates: 18 590652 E 4718055 N Water 24.4 C

Sampling Site Type (Check one from each row)									
Stream Size	Headwater Tributaries (<20 cfs) ✔			**Creeks and Streams (20-150 cfs)**			**Larger Rivers (>150 cfs)**		
Gradient	FAST (primarily riffle)			VARIED (pools and riffles)			SLOW (low gradient) ✔		
Surrounding Land Use	Forested ✔		Agricultural		Residential			Urban	
	dense ✔	sparse	pasture-land	crop-land	rural	village	suburban	resident-ial	commercial/industrial

Upstream Dam: Ã Yes Ã No ✔ The stream is on average 4 meters wide and 0.5 meters deep

How far up stream: ___________

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

Turbidity is substantially greater than natural conditions: Ã Yes Ã No ✔ Describe___________________________

Algal or weed growth: 90 % of bottom covered

Oily film, grease globules, or unusual odor or color present Ã Yes Ã No ✔

Describe:____

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

a) 3 m / 33 = v1 0.09

b) 3 m / 30 = v2 0.095

AVERAGE: 0.095 **m/sec**

NOTE: 0.15 – 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* 8/6/01

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? Good-excellent

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

Site Photos: Site 1 Date 8/6/01

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.

Right Bank

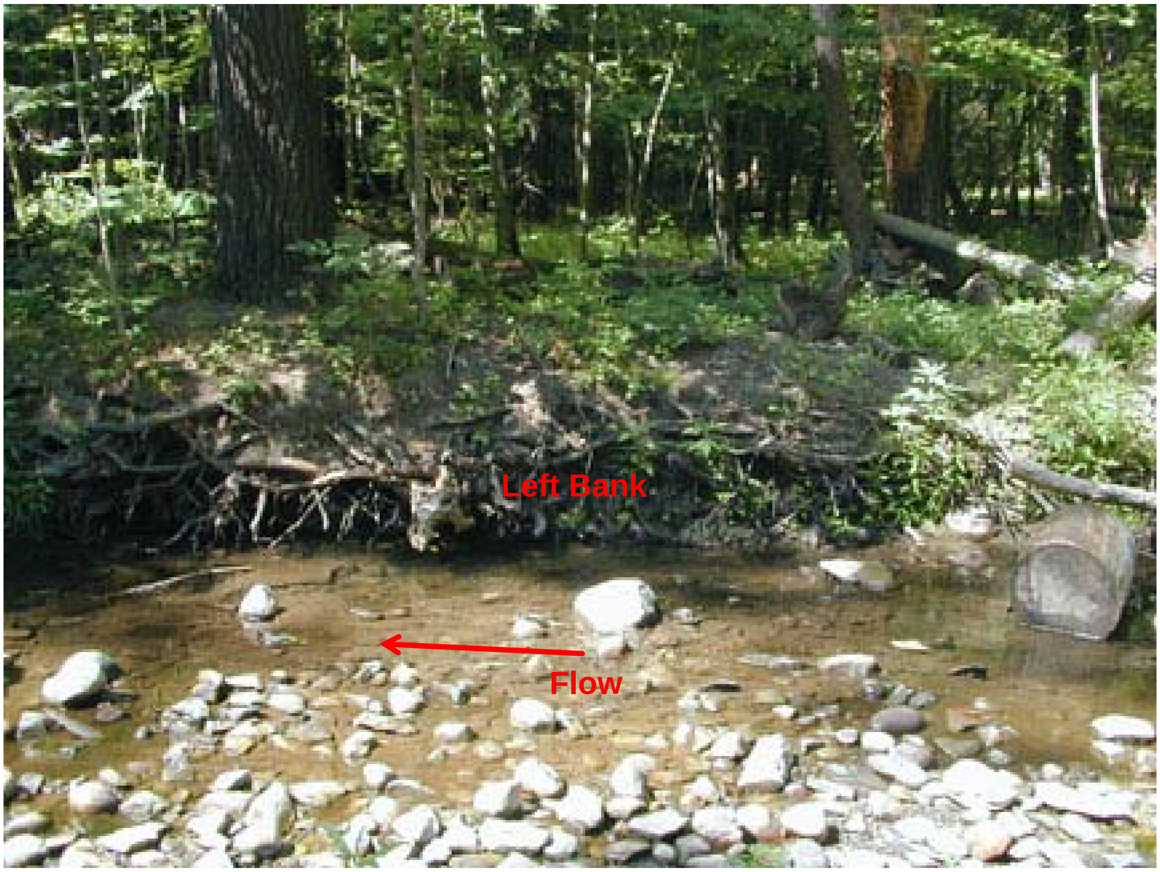
Physical Survey / Habitat Assessment

Site 1 Date 8/6/01

HBRW Tiers 2 & 3

Physical Survey / Habitat Assessment

Site 1 Date 8/6/01



Additional Notes:

Chemical Data Reporting Sheet

Name(s) HBRW Rapid Bioassessment Team School / Group FREEC/LEI

Stream Vloman Kill Date(s) Sampled 8/6/01 Site 1

Today's weather conditions: ☑ clear ❐ cloudy ❐ light rain ❐ heavy rain ❐ other ______ air temp 32 °C water temp 24.4 °C

In the past 24 hours, there was: ❐ light rain ❐ heavy rain ❐ snow ☑ other: Humid, Clear

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	7.60	7.8			7.7	2		pH paper (1-14, by 1), color comparator, pocket meter (1-14, by 0.1), Other:
Alkalinity (mg/l)	150	160			155	2		*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	5 JTU				5 JTU	2		Nephelometer, Other: Turbidity Column, JTU
Conductivity (uS/cm)	510	513			511.5	3		Meter or other:
Nitrate-Nitrogen as: NO_3* ✔ mg/l N (check one)	0.4	0.4			0.4	3		*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)	0.02	0.07			0.05	3		*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)	7.8	7.8			7.8	2		*Modified Winkler Titration*: LaMotte micro-buret, HACH drop count, HACH digital titrator
Dissolved Oxygen (% Saturation)					92%			
Other: add units)								

Describe your QaQc procedures here: HBRW Rapid Bioassessment QAQC

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

Appendage IV

HBRW RWAP Benthic Macroinvertebrate Data Analysis Sheet

Site #: 1
Date Sampled: 8/6/01
Date of Lab Work: 8/6/01
River/Stream: Vloman Kill
Name(s): HBRW Rapid Bioassessment Team
Total # Squares in Tray Grid: 12

	DENSITY (D) AND RICHNESS (R)							
REPLICATE #	1		2		3		AVERAGE (MEAN)	
MAJOR GROUP	D	R	D	R	D	R	D	R
Order: EPHEMEROPTERA	49	1	34	1			41.50	1.00
Order: PLECOPTERA	0	0	0	0			0.00	0.00
Order: TRICHOPTERA	25	3	48	3			36.50	3.00
Order: DIPTERA, Family: CHIRONOMI	5	2	9	2			7.00	2.00
Order: DIPTERA, Family:	8	1	3	1			5.50	1.00
Order: DIPTERA, Family:	0	0	1	1			0.50	0.50
Order: ODONATA	0	0	1	1			0.50	0.50
Order: MEGALOPTERA	1	1	2	1			1.50	1.00
Order: COLEOPTERA	10	1	2	1			6.00	1.00
Order: AMPHIPODA	0	0	0	0			0.00	0.00
Order: ISOPODA	0	0	0	0			0.00	0.00
Order: DECAPODA	0	0	0	0			0.00	0.00
Class: GASTROPODA	2	1	0	0			1.00	0.50
Class: PELECYPODA	0	0	0	0			0.00	0.00
Class: OLIGOCHAETA	0	0	0	0			0.00	0.00
Class: HIRUDINEA	0	0	0	0			0.00	0.00
Order: OTHER	0	0	0	0			0.00	0.00
TOTALS	**100**	**10**	**100**	**11**	**0**	**0**	**100.00**	**10.50**

	1	2	3	Mean
# SQUARES PICKED FROM TRAY	8	10		9.00
ORGANISM DENSITY PER SAMPLE UNI	150	120	#####	133
TOTAL TAXA (FAMILY) RICHNESS	10	11	0	11
EPT RICHNESS	4	4	0	4
EPT/EPT+CHIRONOMIDAE RATIO	0.94	0.90	#####	0.92

% Model Affinity = 0.72

% COMPOSITION OF MAJOR GROUPS =

Ephemeroptera	= 41.50	÷	100.00	=	0.42
Plecoptera	= 0.00	÷	100.00	=	0.00
Tricoptera	= 36.50	÷	100.00	=	0.37
Chironomidae	= 7.00	÷	100.00	=	0.07
Other Diptera	= 6.00	÷	100.00	=	0.06
Odonata	= 0.50	÷	100.00	=	0.01
Megaloptera	= 1.50	÷	100.00	=	0.02
Coleoptera	= 6.00	÷	100.00	=	0.06
Amphipoda	= 0.00	÷	100.00	=	0.00
Isopoda	= 0.00	÷	100.00	=	0.00
Decapoda	= 0.00	÷	100.00		0.00
Gastropoda	= 1.00		100.00		0.01
Pelecypoda	= 0.00		100.00		0.00
Oligochaeta	= 0.00		100.00		0.00
Hirudinea	= 0.00		100.00		0.00
Other	= 0.00		100.00		0.00

MAJOR GROUP BIOTIC INDEX

Organism	#	Tolerance	Total
Ephemeroptera	41.50	2	83
Plecoptera	0.00	1	0
Tricoptera	36.50	3	109.5
Chironomidae	7.00	7	49
Other Diptera	6.00	4	24
Odonata	0.50	5	2.5
Megaloptera	1.50	2	3
Coleoptera	6.00	4	24
Amphipoda	0.00	7	0
Isopoda	0.00	8	0
Decapoda	0.00	6	0
Gastropoda	1.00	7	7
Pelecypoda	0.00	7	0
Oligochaeta	0.00	9	0
Hirudinea	0.00	7	0
Other	0.00	0	0
Totals	**100**	**XXX**	**302**

Biotic Index Value/Total # Organisms = 3.02

Levels of Impact	
	0 - 4.50 non-impacted
	4.51 - 6.50 slightly impacted
	6.51 - 8.5 moderately impacted
	8.51 - 10.00 severely impacted

THE RATIONAL OF BIOLOGICAL MONITORING

Biological stream monitoring as applied here refers to the use of resident benthic macroinvertebrate communities as indicators of water quality. Macroinvertebrates are larger-than-microscopic invertebrate animals that inhabit aquatic habitats; freshwater forms are primarily aquatic insects, worms, clams, snails, and crustaceans.

Concept:
Nearly all streams are inhabited by a community of benthic macroinvertebrates. The species comprising the community each occupy a distinct niche defined and limited by a set of environmental requirements. The composition of the macroinvertebrate community is thus determined by many factors, including habitat, food source, flow regime, temperature, and water quality. The community is presumed to be controlled primarily by water quality if the other factors are determined to be constant or optimal. Community components which can change with water quality include species richness, diversity, balance, abundance, and presence/absence of tolerant or intolerant species. Various indices or metrics are used to measure these community changes. Assessments of water quality are based on metric values of the community, compared to expected metric values.

Advantages:
The primary advantages to using macroinvertebrates as water quality indicators are:

1. they are sensitive to environmental impacts
2. they are less mobile than fish, and thus cannot avoid discharges
3. they can indicate effects of spills, intermittent discharges, and lapses in treatment
4. they are indicators of overall, integrated water quality, including synergistic effects and substances lower than detectable limits
5. they are abundant in most streams and are relatively easy and inexpensive to sample
6. they are able to detect non-chemical impacts to the habitat, e.g. siltation or thermal changes
7. they are vital components of the aquatic ecosystem and important as a food source for fish
8. they are more readily perceived by the public as tangible indicators of water quality
9. they can often provide an on-site estimate of water quality
10. they can often be used to identify specific stresses or sources of impairment
11. they can be preserved and archived for decades, allowing for direct comparison of specimens
12. they bioaccumulate many contaminants, so that analysis of their tissues is a good monitor of toxic substances in the aquatic food chain

Limitations:
Biological monitoring is not intended to replace chemical sampling, toxicity testing, or fish surveys. Each of these measurements provides information not contained in the others. Similarly, assessments based on biological sampling should not be taken as being representative of chemical sampling. Some substances may be present in levels exceeding ambient water quality criteria, yet have no apparent adverse community impact.

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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.

(The above reprinted by permission, Bob Bode, NYS DEC Stream Biomonitoring Unit)

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 Indexes

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

Major Group Biotic Index:
This is a coarse estimate of the pollution tolerance of the community based on estimated pollution tolerances of the major groups that make up the aquatic insect community. Each major group is assigned a pollution tolerance value from 0-10, with 0 being intolerant and 10 being the most tolerant. These are based on pollution tolerance values for the most commonly found families in each major group. The index is calculated as follows (using tolerance values appropriate to New England):

1. Multiply the average density for each major group (from the Identification Sheet) by the tolerance value for that group.
2. Add all of the results for each major group.
3. Divide this number by the total average density (# of organisms picked) from the Identification Sheet). 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 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.