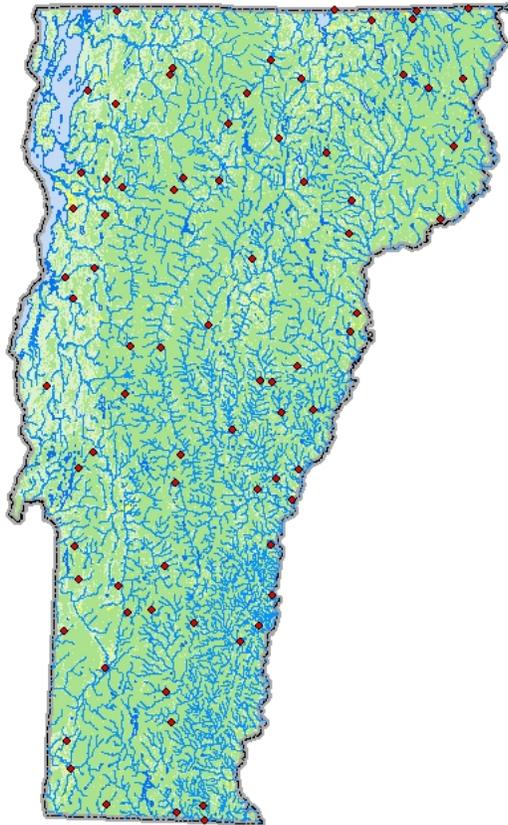


DRAFT 030408

**A Probability-Based Comprehensive  
Statewide Assessment of Wadeable  
Stream Biological Condition  
Vermont  
2002-2006**



State of Vermont, James Douglas, Governor  
Vermont Agency of Natural Resources, George Crombie, Secretary  
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Commissioner  
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Biomonitoring and Aquatic Studies Section

March 4, 2008

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## Acknowledgements

This project is the product of the collaborative efforts of many individuals and institutions. Primary acknowledgements go to Jen Stamp, Environmental Technician with the VTDEC Biomonitoring and Aquatic Studies Section. Jen is the primary author of this report, which would not have been possible without her expertise, commitment and tenacious persistence in the face of legacy staff inertia and logistical deficits. Thanks Jen for putting it all together. Jen established many collaborations, primarily with USEPA staff at the Narragansett Regional Laboratory and Vermont Agency of Natural Resources (ANR) GIS staff. Hal Walker, Jim Heltshe and Jane Copeland at the Narragansett Laboratory provided invaluable technical assistance with study design and statistics, provided site selection lists and maps, and generally provided the theoretical and logistical underpinnings of the entire project under at times somewhat chaotic circumstances. Many thanks to the folks at Narragansett. GIS staff Steve Gaughn and Peter Telep at the Vermont Agency of Natural Resources were instrumental in developing the underlying data bases, maps and analyses associated with this project. Many thanks to Steve and Peter. Thanks to USEPA staff, particularly Pete Nolan and Hilary Snook and their technical staff at Region 1 for their dedicated ideological and financial support of this project and technical implementation assistance. Also thanks to the participants of the New England Wadeable Stream project for maintaining a dedication to finding ways to develop the means for disparate monitoring and assessment entities to evaluate monitoring data, using the concepts of the Biological Condition Gradient, from different sampling methodologies to arrive at comparable assessment end points. And finally, thanks to the staff of the Biomonitoring and Aquatic Studies Section – Steve Fiske, Rich Langdon, Rick Levey, Jim Kellogg, Heather Pembroke, Doug Burnham, Brian Duffy - for their dedication to this project.

## Executive Summary

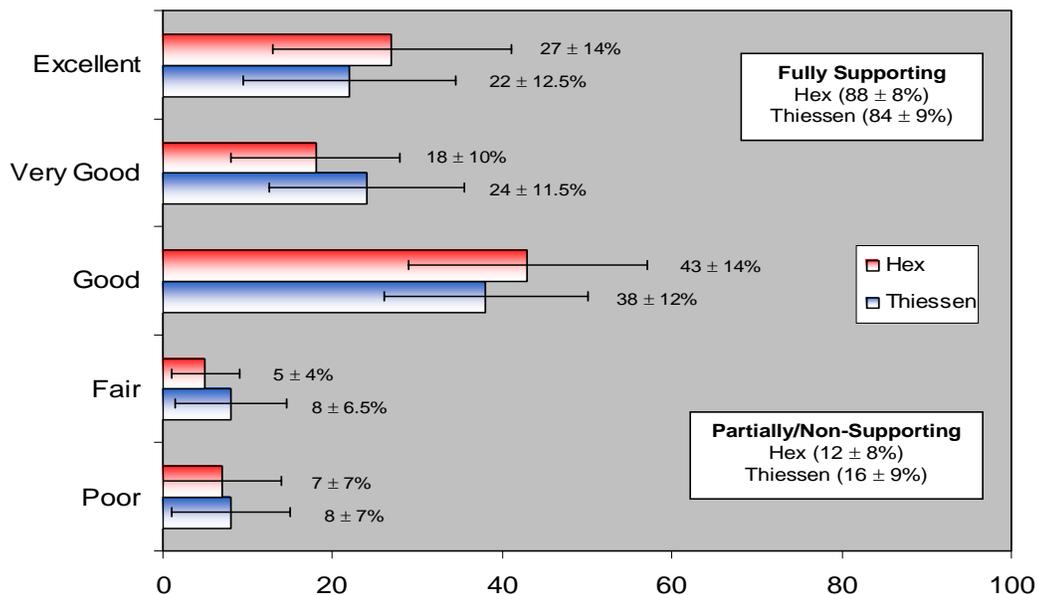
The Vermont Department of Environmental Conservation (VTDEC) conducts annual biological monitoring and assessment of fish and macroinvertebrate communities in streams and rivers throughout Vermont. The purpose of this monitoring is to determine the biological condition of assessed sites in relation to aquatic life use designations articulated in the Vermont Water Quality Standards (WQS). In order to provide a comprehensive assessment of the overall condition of Vermont's wadeable stream resources, VTDEC collaborated with USEPA to implement a probability-based monitoring and assessment study that would provide the basis for estimating the overall biological condition of Vermont's wadeable stream resources. Standardized monitoring and assessment activities were conducted in accordance with a five-year rotational watershed monitoring plan whereby each year one fifth of the state's watersheds are assessed, with entire state coverage being accomplished at a five year interval.

From 2002-2006, fish and macroinvertebrate community assessments were made at 78 randomly selected wadeable stream sites across the state. Assessment results were related to a determination of aquatic life use support pursuant to the Vermont WQSs. The results, based on a hexagon overlay study design, were used to provide a statistically defined estimate of the aquatic life use support status of assessed wadeable streams in Vermont. An alternative study design based on Thiessen polygons was evaluated and recommended for future probability assessments. Results for the two analyses are depicted in the figure below expressed as the percent of total wadeable stream miles in five biological condition categories with 95% confidence limits. For example, for the Hex design analysis, we can say with 95% certainty that between 80-96% of Vermont wadeable streams fully support aquatic life uses.

This project demonstrates the potential for utilizing monitoring data from different aquatic communities (fish and macroinvertebrates) and methodologies (VTDEC, USEPA) to arrive at consistent assessment conclusions derived from Biocondition Gradient (BCG) theory in the context of tiered aquatic life uses, as articulated in the Vermont Water Quality Standards.

This project also demonstrates a potential means for states to incorporate probability monitoring and assessment activities into their routine monitoring and assessment programs in a sustainable manner that meets the goals of the Clean Water Act without unduly diverting limited resources away from state water quality management priorities.

### Assessment Summary Findings: Percent of Total Vermont Wadeable Stream Miles in Biological Condition Categories





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## INTRODUCTION

The Vermont DEC Biomonitoring and Aquatic Studies Section (BASS) has conducted targeted monitoring of Vermont's wadeable streams since the 1980s. Referred to as the ambient biomonitoring program, the BASS monitoring crews assess the biological health of Vermont's aquatic environment through chemical and physical assessments and the sampling of macroinvertebrate and fish communities. BASS selects its biomonitoring sites for a variety of reasons. These include: long-term trend and natural condition monitoring of reference-quality sites; compliance biomonitoring of permitted discharges; site assessment and monitoring for impaired water listings, watershed planning, mitigation evaluation, enforcement actions and hazardous waste site remediation; and monitoring current biological condition of areas that may be impacted by future construction or development. Long-term monitoring sites within each major watershed basin are generally sampled at least once every five years as part of the State's rotational survey approach.

Although very effective at answering reach-specific questions regarding biological condition, targeted monitoring has limitations for drawing conclusions regarding estimates of overall statewide resource condition. Site selection is biased relative to the resource as a whole, with the focus tending to be on assessing potentially degraded waters. Therefore scientifically-defensible statements can only be made about the condition of the waters at these sites, not on the overall quality of Vermont's wadeable streams. Because of these limitations, and because of a demand to better report on the condition of aquatic resources as a whole for Section 305(b) of the Clean Water Act, there was an initiative in the late 1990s to start conducting more scientifically valid and comprehensive probabilistic surveys at the federal, regional and state levels<sup>1</sup>.

In probability-based surveys, one can use statistics with known confidence levels to assess the condition of a target population as a whole based on data collected from a representative subsample of locations. First, a target population (i.e. wadeable streams) is identified and clearly defined. Next, an appropriate survey design is developed to randomly select a subset of that population. Once the condition of this subset of sites is assessed, statistics can be used to make scientifically valid statements about the target population as a whole. For the purpose of estimating overall resource condition, probability-based designs are much more efficient and cost-effective than their alternative, a census, in which every single unit of the target population must be assessed.

While BASS recognized the utility of using a probability-based survey to assess the biological condition of its wadeable streams, it did not want to take resources away from its well-established ambient biomonitoring program. BASS decided that the probability-based survey would only be conducted if it did not put undue burden on its limited

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<sup>1</sup> Examples include the Wadeable Streams Assessment (WSA), which was a nationwide assessment of wadeable streams. The US EPA sampled eight sites in Vermont as part of this project. Another example is the New England Wadeable Streams project (NEWS), which was a regional survey in which 50 sites were sampled in Vermont from 2002-2003.

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monitoring resources yet had a large enough sample size to provide results with reasonable statistical validity. It therefore tried to create a sustainable probability-based sampling program that could be integrated into its existing ambient biomonitoring framework. VTDEC made its first attempt at such a program in the year 2000. In a collaborative effort with the US EPA, an experimental design was developed that blended Vermont's existing site locations from its 1990-2000 macroinvertebrate and fish datasets with random site selection, and used an association rule (nearest distance) to link the random sites with the existing sites. This approach ultimately proved to be unsuccessful; the results were not statistically valid because the existing sites were not selected randomly and the bias in the preferential (targeted) site selection could not be defined. VTDEC's second attempt was based on the rotational hex survey. Vermont was able to successfully complete this project by sampling 78 randomly-selected sites throughout the state over a five-year period, 2002-2006.

## GOALS AND PURPOSE OF THE ROTATIONAL HEX SURVEY

The purpose of the rotational hex survey was to assess and report on the overall biological condition of Vermont's perennial wadeable streams. Included in this report will be scientifically-defensible statements about the number and proportion of perennial wadeable stream miles that are fully, partially and non-supporting Vermont's aquatic life use standards, as set forth in the Vermont Water Quality Standards. Data derived from this project will be used mainly for the 305(b) report on the state of the State's waters. The data may also allow for a quantifiable characterization of perennial wadeable streams. For example, a better estimate of the proportion of perennial wadeable stream miles that are categorized as small high gradient, medium high gradient, warm water moderate gradient and slow winder, and of the general biological conditions of each stream type will be possible. Also of interest will be the proximity of the stream miles to roads.

## METHODS

***Sampling design.*** The US EPA developed a five-year rotational hex random sampling design. A series of grid systems consisting of 15 hexagonal shaped "cells" were laid over the rotational basins that were being sampled as part of the ambient biomonitoring program (**Figures 1 & 2**). At least one site had to be sampled within each hex, and the randomly selected sites for a given year had to be located in the same basins being sampled as part of the ambient biomonitoring program. VTDEC believed that 15 was a reasonable number of sites per year that could be assessed for biological condition without placing an undue burden on its limited monitoring resources. It was understood that the data, due to sample size limitations, would have limited statistical worth when analyzed on a yearly basis; but that seventy-five sites over five years would be a large enough sample size to provide statewide results with reasonable statistical validity.

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**Site selection.** The USEPA used a 1:100,000 scale National Hydrographic Database (NHD) dataset of Vermont's wadeable streams<sup>2</sup> to derive the list of randomly selected sites. This stream layer contained a total of 7,275 stream miles. Computer software was used to randomly select three possible sampling sites within each hexagon (**Table 1**). Redraws were requested if the crew was unable to sample any of the three choices. Field crews were permitted to move sampling locations up to 1.5 miles upstream or downstream from the assigned point when necessary (i.e. assigned site was inaccessible due to difficult terrain, private property restrictions, or extensive wetland areas), as long as there were no apparent changes in site conditions (i.e. land use, stream type) from what would be expected at the originally assigned location.

**Table 1: Example of Site Selection Options**

An example of the list of possible sampling sites (or 'picks') that was provided by the US EPA for each hex.

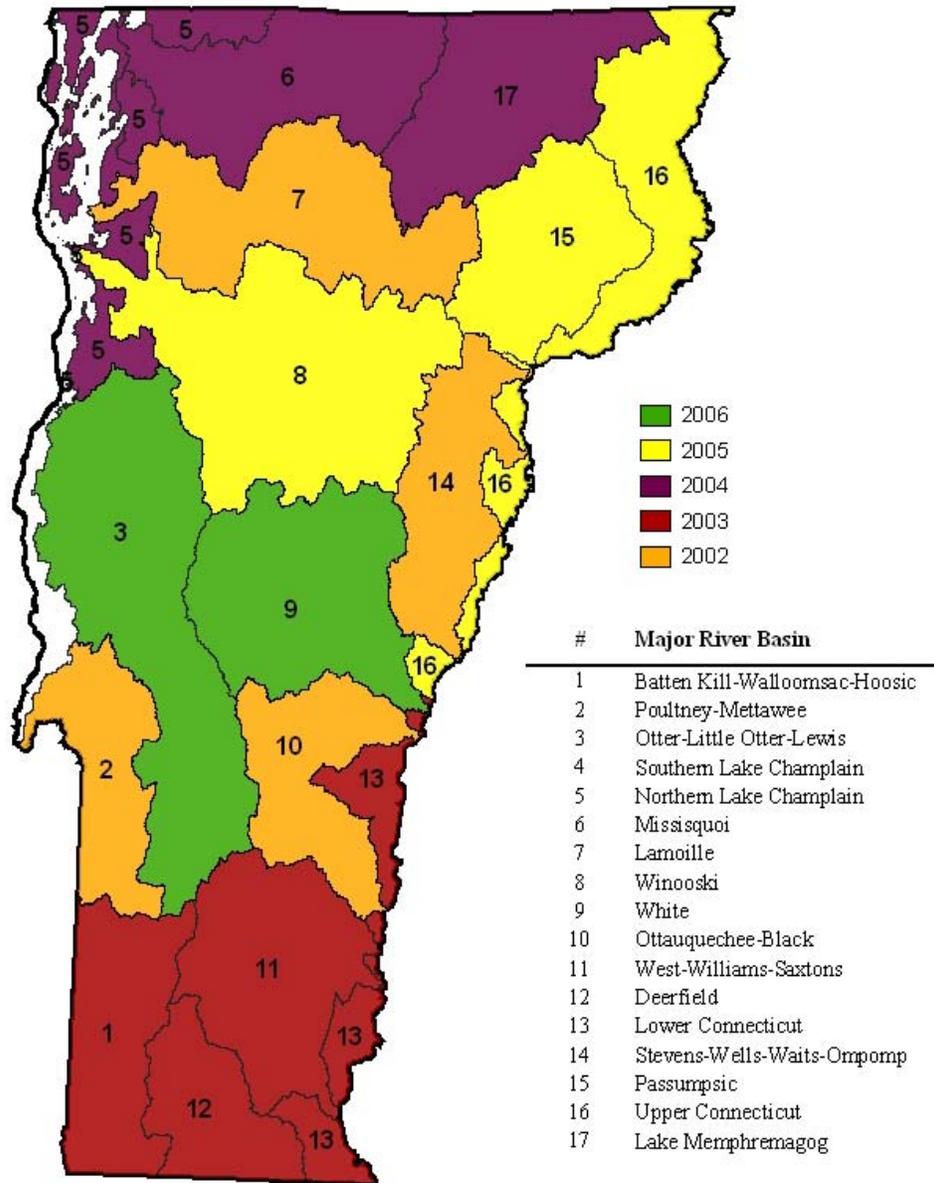
Hex #	Pick #	Longitude (D.D°)	Latitude (D.D°)	Stream Name
1	1	-73.15912	43.40927	Wells Brook
1	2	-73.09601	43.36855	Flower Brook
1	3	-73.11215	43.29386	Unnamed Trib to Mettawee River

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<sup>2</sup> The following segments were removed from the original 1:100K NHD stream layer to derive the perennial wadeable stream units: anything called a connector (fcode 33400- these connect a stream from its end point at a lake or pond to its beginning on the other side of the waterbody) or artificial path (fcode 55800 - they are the centerlines of double-lined rivers, which are assumed to be too large to be wadeable); and any segment designated as intermittent (Jane Copeland email, Nov 2006). For more detailed descriptions of the sampling design contact Hal Walker, Walker.Henry@epamail.epa.gov.

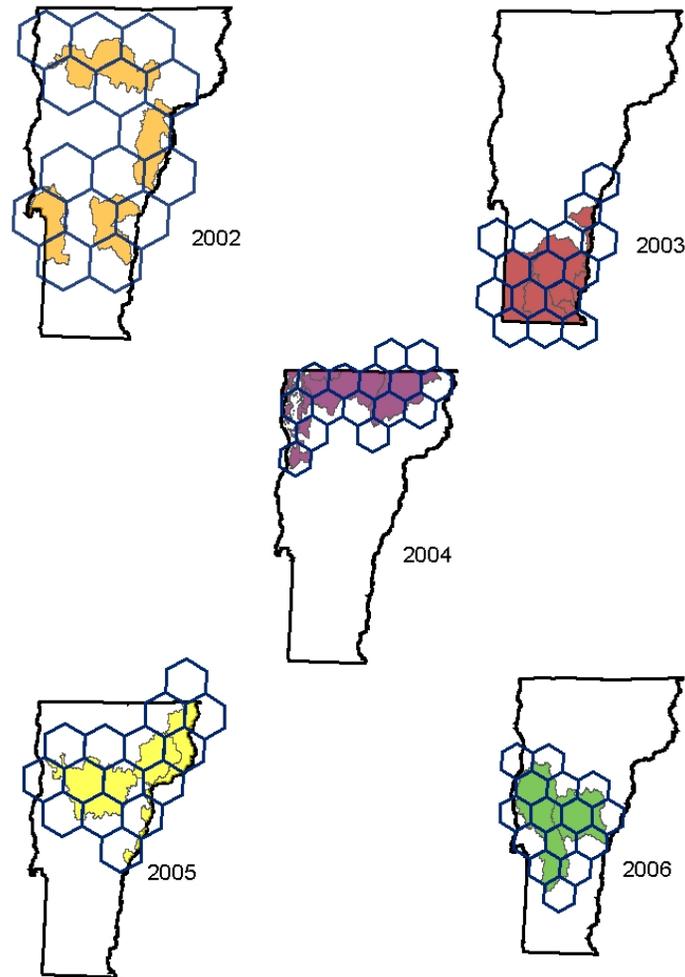
**Figure 1: 17 Major Vermont River Basins**

There are 17 major river basins in Vermont. Biomonitoring crews sample sites within each basin once every five years as part of the ambient biomonitoring program. Sites sampled for the rotational hex project followed the same rotational schedule. Basins are color-coded to show what year each basin was sampled.



## Figure 2: Rotational Hex Random Sampling Design

The 2002-2006 Rotational Hex Random Sampling Design. Each rotational basin is overlaid by a grid of fifteen hexagons.



**Site elimination.** Sites were eliminated for four main reasons: they were too deep (i.e. non-wadeable); they were too close to lake or pond outlets (the temperature and fine particulate organic material dynamics near lake outlets create anomalous biological conditions that are outside the scope of Vermont DEC's wadeable stream biocriteria parameters); they were intermittent; or they were located in extensive wetland areas (reasons similar to lake outlet proximity). Much of the site evaluations were done in the laboratory using 1:24,000 scale USGS topo maps and 1:5000 ortho photos.

**Sample Collection and Processing Methods.** Attempts were made to sample both macroinvertebrate and fish communities at every site, preferably on the same day. Because the New England Wadeable Stream (NEWS) project was being conducted

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concurrently with the rotational hex survey from 2002-2003<sup>3</sup>, and because the two projects utilized different macroinvertebrate collection methods, there were inconsistencies in the sampling methodology for the rotational hex dataset. NEWS samples were collected from a mix of mesohabitats (multi-habitat) within the reach (i.e. pools and riffles), while samples collected using the Vermont method were taken from riffle habitat only. The collection methods are described in greater detail below.

The sampling periods also differed. Samples collected using the Vermont methodology were taken during the late summer/early fall index period, from September to mid-October, while the NEWS samples were collected from June through August. At some sites the NEWS fish and macroinvertebrate data were used in the rotational hex dataset because these were the only data available for those sites. At sites where data from both collection methods was available, data from the Vermont kick net or sweep method was used.

***Macroinvertebrate collection - VT kick net method.*** A D-frame net with a 500 micron mesh size is used in a standardized kick-net sampling procedure. Samples are collected from representative riffles within the stream reaches being evaluated. The area immediately upstream of the net is thoroughly disturbed by hand, ensuring that all pieces of substrate are moved and rubbed clean of attached organisms. This is repeated moving upstream at four different riffle habitat locations that represent the full range of water velocity in the riffle, for a total of 2 minutes (timed) of active sampling. Sampling effort is comparable to RBP III as described in Plafkin et al (1989) (VT DEC, 2006).

***Macroinvertebrate collection - VT sweep method.*** The D-frame net is jabbed into debris jams, vegetation or root wads in the representative run habitat within the low gradient reach. After the jab, the net is pulled back rapidly to dislodge organisms, and then swept forward again in the same area to scoop up the dislodged organisms. The jabbing and sweeping motions are repeated several times in the same area. This is considered to be one jab; a total of four jabs are taken within the sampling reach and are combined into one composite sample (VT DEC, 2006).

***Macroinvertebrate collection - NEWS method.*** A 1/5 meter square quadrat is randomly tossed within a particular meso-habitat of the stream reach. Twenty quadrats are collected within the stream reach for a bottom surface area of 4 square meters. Quadrat collections are timed for one minute, during which all substrate is rubbed and the bottom fines disturbed to a depth of approximately 3 centimeters. Samples are collected at each site in proportion to the existing habitat in the reach; if the reach consisted of half riffle and half pool habitat, then 10 quadrats would be pulled from the pool and ten from the riffle areas (Davies, 2005).

***Macroinvertebrate processing.*** Samples collected using the Vermont kick net and sweep methods were processed in the Vermont DEC laboratory using the Vermont processing method. Preserved (ethanol) samples are spread out on a gridded tray and organisms are

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<sup>3</sup> Data from forty-eight of the sites sampled for the NEWS project from 2002-2003 was also used in the rotational hex study. Sites sampled for the NEWS project were derived from the list of randomly selected sites generated by the rotational hex design.

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picked from the debris in a methodical manner. Minimum sub-sample requirements are at least 25 percent of the entire sample and a minimum of 300 organisms (or the entire sample if less than 300 organisms). All organisms are identified to the lowest practicable taxonomic level, usually genus or species (VTDEC, 2006). Samples collected using the NEWS method were sent to a contracted lab, EcoAnalysts, where a 200-organism sub-sample was taken and identified to the lowest practicable taxonomic level.

***Fish sampling.*** Fish sampling occurred in stream sections that were judged to be representative of the overall stream reach being assessed. The NEWS project utilized a stream segment shocking length of 150 meters. For non-NEWS sites, samples were collected from section lengths ranging from 70 to 200 meters. Sampling was conducted using standard electroshocking methods. Sections were shocked from downstream to upstream with a backpack electro-fishing unit. In larger wadeable streams, two backpack electro-fishers were used. One to three passes were made over the entire section. All stunned fish observed were captured, identified, examined for anomalies and released following completion of sampling, with the exception of individuals kept for further taxonomic identification or pathological purposes.

***Physical habitat.*** A number of physical habitat measures were recorded during most of the biological sampling events. These measurements included: wetted and bank full width, depth, water velocity, water temperature, weather conditions, substrate composition (both observational and pebble count techniques), substrate embeddedness, silt rating, canopy cover and stream bank condition. Periphyton cover observations were also made at sites where pebble counts were conducted (VT DEC, 2006).

***Water chemistry.*** In-situ measurements were taken at many of the sites during the biological sampling events. Parameters included temperature, pH, and conductivity. At some sites additional analyses were done to test levels of potential stressors such as nutrients, metals, and alkalinity. The methods used for collection, transport and analysis of water samples are documented in the Water Quality Division Field Methods Manual (VT DEC, 2006).

## **ASSIGNMENT OF BIOLOGICAL RATINGS**

Either Vermont DEC wadeable stream biocriteria or best professional judgment was used to assign a biological rating to a site. For macroinvertebrate samples, application of Vermont DEC biocriteria was used at sites that were categorized as small high gradient, medium high gradient and warm water moderate gradient; best professional judgment was used to assign ratings to slow winders (low gradient streams). Best professional judgment was also used to assign ratings to sites that only had NEWS data. For fish surveys, application of the appropriate Vermont DEC Index of Biotic Integrity (IBI) was used to assign biological ratings to sites that could be categorized as cold water (CWIBI) or mixed water (MWIBI) habitat. Best professional judgment was used to assign ratings at a few slow winder sites. No assessments were made at sites that had only one species present (i.e. brook trout), at sites that had too short a sampling reach, and at most of the sites categorized as slow winder (lack of appropriate reference condition knowledge).

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Sites could be assigned five possible overall biological ratings: excellent, very good, good, fair and poor. These biological ratings are congruent with and derived from Biological Condition Gradient (BCG) theory. Best professional judgment determinations were made with reference to BCG considerations and theory. Sometimes macroinvertebrate samples were assigned a threshold rating (i.e. good-fair, exc-vgood). In these situations, the higher of the two ratings was used. Sites that rate excellent, very good and good are considered to be fully supporting aquatic life use standards (ALUS); those that rate 'fair' are partially supporting ALUS; those that rate 'poor' are non-supporting of ALUS. When macroinvertebrate and fish ratings differed, the lower of the two ratings was used when assigning an overall rating to a site. For the purposes of this discussion, both partial and non-support indicate a failure to meet minimum Class B water quality standards.

The five biological ratings are consistent with the tiered aquatic life uses articulated in the Vermont Water Quality Standards: Excellent = minimal change from reference condition (Class A1); Very Good = minor change from reference condition (Class B1); Good/Fair = moderate change from reference condition (Class A2, B2, B3); Poor = non-attainment of minimal Class B aquatic life use.

## ANALYSIS

Sites were weighted unequally. Weights were calculated for each site based on the number of perennial wadeable stream miles in the hex,<sup>4</sup> so that sites in hexes with more stream miles received more weight in the analysis. The assumption was that the biological rating assigned to a site represented the biological condition of all the wadeable streams in the entire hex in which the site was located.

Weights were calculated using the following equation:

$$\text{Hex Weight} = \text{Total Wadeable Stream Miles in Hex} \div 7275^5$$

In three of the hexes, two sites were sampled. In these cases, the weight assigned to the hex was divided by two so that each site received an equal weight within that hex.

To determine the proportion of stream miles in each biological condition, sites were grouped together based on their biological rating (i.e. all the sites that rated 'excellent' were grouped together, all the sites that rated 'good' were grouped together, etc.). The sum of the weights of the sites in each group equals the proportion of total wadeable stream miles in Vermont in each biological condition category. A table of these calculations and of the weights assigned to each site can be found in **Appendix 1**.

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<sup>4</sup> An alternate analysis using Thiessen polygons was also performed. See Part 2 – "Alternate Analysis" for details.

<sup>5</sup> The number 7275 represents the total number of wadeable stream miles in Vermont (using the 1:100K NHD stream layer).

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95% confidence intervals were calculated to measure how precise the biological rating estimates were and to give an indication of how confident VTDEC could be in the results. The calculations were somewhat complicated due to the unequal weighting of sites. US EPA statistician Jim Heltshe developed an Excel spreadsheet to calculate confidence intervals using a jackknife technique, and this spreadsheet was used to derive the 95% confidence intervals used in this report<sup>6</sup>.

Because some proportion of the target population of perennial wadeable streams was excluded from the analysis based on some *a priori* exclusionary criteria, the final step of the analysis was to estimate the actual number of perennial wadeable stream miles that were ultimately considered to be “assessed” in each rotational basin, and the number of stream miles that were excluded in each rotational basin. To derive these numbers, all of the randomly selected sites, or ‘hex picks,’ provided to us by the US EPA (three or more per hex) for each rotational basin were viewed on 1:24,000 scale USGS topo maps, and a determination was made as to whether or not the sites were within the target population (perennial wadeable streams). Sites were excluded if the stream at the assigned location was too deep, was too close to lake or pond outlets, was intermittent (depicted as dotted lines on the topo maps), or was located in extensive wetland areas where there was no clear channel. The number of excluded sites was tallied, as were the number of sites that fell within the target population. To calculate the proportion of stream miles in a rotational basin that were excluded from the target population, the number of excluded sites was divided by the total number of sites on the list of ‘hex picks.’ To calculate the proportion of stream miles that were assessed within each basin, the number of sites that fell within the target population was divided by the total number of sites on the list of ‘hex picks.’ These proportions were multiplied by the total number of stream miles in the rotational basin to derive the number of stream miles that were assessed and excluded. The most common reasons why stream miles were excluded were because they appeared to be intermittent and because they were too close to lake/pond outlets. The highest proportion of sites (0.35) was excluded from the 2002 rotational basin. For further information reference **Appendix 2**. During this process the distance of sites from the closest roads was measured.

## RESULTS

Seventy-eight total sites were sampled throughout Vermont from 2002-2006 (**Figure 3**). Sixty-four of the sites were fully supporting aquatic life use standards (ALUS), eight were partially supporting ALUS, and six were not supporting ALUS (**Table 2**). These numbers are based on ratings derived from the combined macroinvertebrate/fish dataset. At least two or more sites were sampled in sixteen of the major river basins. The largest river basin, Otter-Little Otter-Lewis Creek, had the most sites (n=10), while the smallest river basin, Southern Lake Champlain, contained no sites.

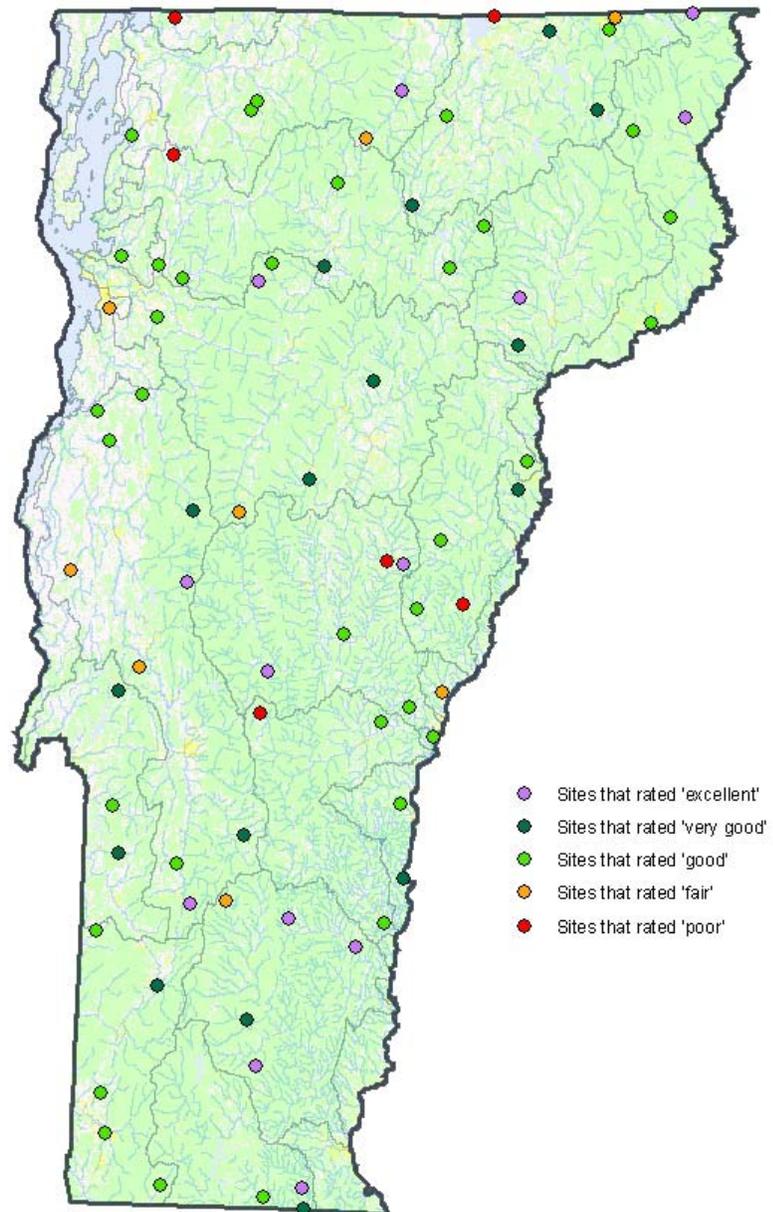
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<sup>6</sup> The R software cdf function provides a very similar result. Contact Hal Walker for further details.

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## Figure 3: 78 Randomly Selected Assessment Sites

Seventy-eight randomly selected sites were sampled from 2002-2006. Sites are color-coded to show their overall biological rating. Ratings were derived from the combined fish/macrobenthos dataset.



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**Table 2: Summary of Site Biological Condition Results by Major River Basin**

A summary of the number of sites sampled within each major river basin and of the biological ratings that each site received. Ratings were derived from the combined fish/macroinvertebrate dataset.

Basin	Area (km <sup>2</sup> )	Stream Miles (1:100K)	# Sites Sampled	Overall Biological Rating				
				Exc	VGood	Good	Fair	Poor
Batten Kill-Walloomsac-Hoosic	1176	273	5	0	1	4	0	0
Deerfield	821	262	3	1	1	1	0	0
Lake Memphremagog	1526	386	7	0	3	2	1	1
Lamoille	1872	539	6	0	1	4	0	1
Lower Connecticut	775	404	3	0	1	2	0	0
Missisquoi	1594	398	4	1	0	2	1	0
Northern Lake Champlain	1045	150	4	0	0	2	1	1
Ottawaquechee-Black	1107	503	3	0	0	2	0	1
Otter-Little Otter-Lewis	2844	780	10	2	2	4	2	0
Passumpsic	1306	362	2	1	1	0	0	0
Poultney-Mettawee	964	202	3	0	2	1	0	0
Southern Lake Champlain	249	43	0	0	0	0	0	0
Stevens-Wells-Waits-Ompomp	1137	369	4	0	0	3	0	1
Upper Connecticut	1607	420	7	2	1	3	1	0
West-Williams-Saxtons	1590	703	5	3	1	0	1	0
White	1843	761	5	2	0	2	0	1
Winooski	2753	720	7	1	2	3	1	0
<b>Totals</b>	<b>24209</b>	<b>7275</b>	<b>78</b>	<b>13</b>	<b>16</b>	<b>35</b>	<b>8</b>	<b>6</b>

The weighted site calculations for the combined macroinvertebrate/fish dataset show that 88% of the assessed perennial wadeable stream miles in Vermont are fully supporting ALUS, 5% are partially supporting ALUS and 7% are not supporting ALUS (**Figure 4**). When interpreted using confidence intervals, one can say with 95% confidence that 80-96% of the perennial wadeable stream miles are fully supporting ALUS, 1-9% are partially supporting ALUS, and 0-14% are not supporting ALUS.

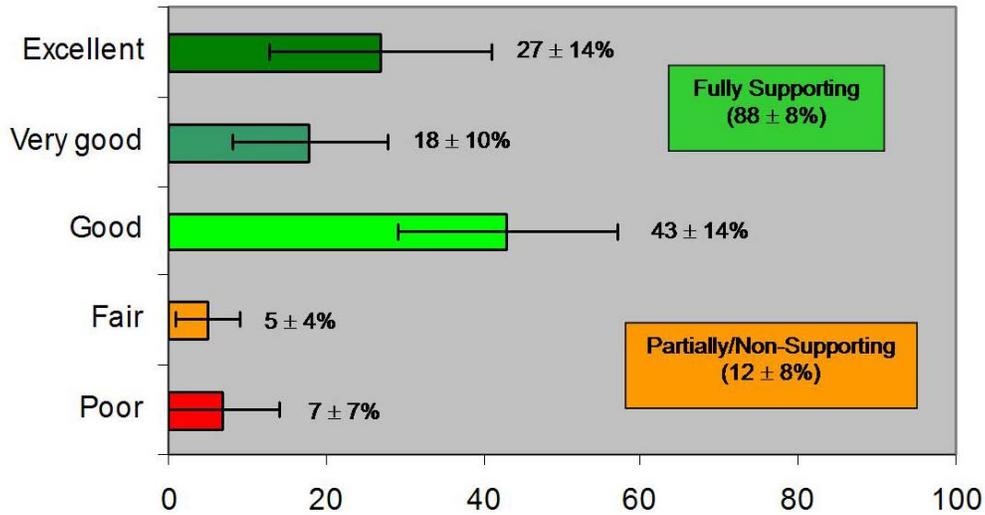
It was estimated that 5343 of the 7275 (73%) stream miles in the 1:100K NHD wadeable stream layer were assessed during the rotational hex survey (**Table 3**). Of these assessed stream miles, 4702 are fully supporting ALUS, 267 stream miles are partially supporting ALUS, and 374 stream miles are not supporting ALUS<sup>7</sup>.

<sup>7</sup> These numbers were calculated as follows: 4702 = 5343 x 0.88; 267 = 5343 x 0.05; 374 = 5343 x 0.07.

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**Figure 4: Percent of Assessed Stream Length by Biological Condition Category**

The percentage of assessed stream length in each biological condition. Streams in excellent, very good and good condition are fully supporting Vermont's aquatic life use standards (ALUS), those in fair condition partially support ALUS, and those in poor condition are non-supporting ALUS. Ratings were derived from the combined fish/macroinvertebrate dataset. The error bars represent 95% confidence intervals.



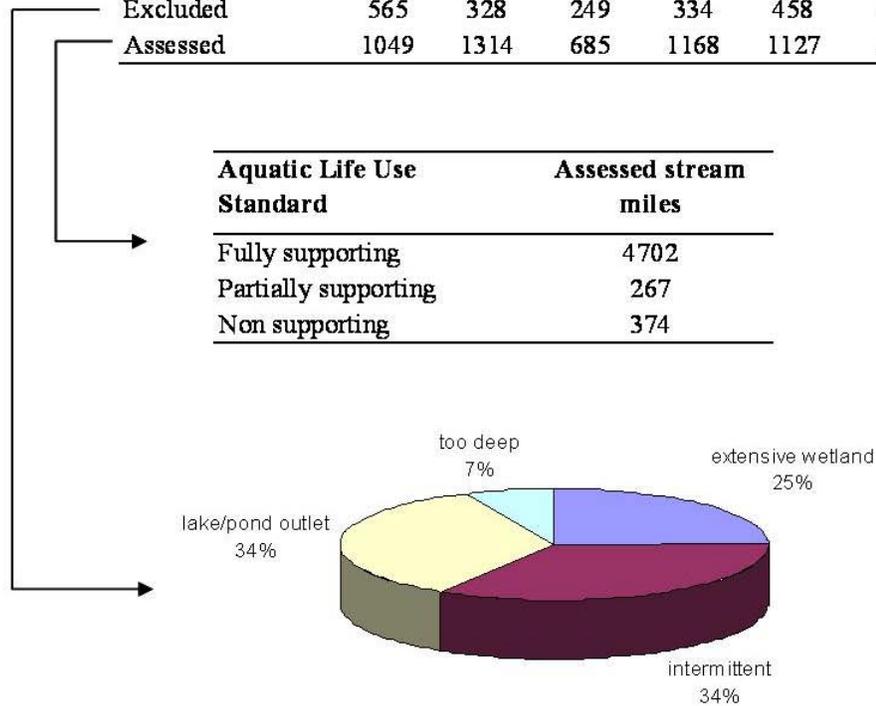
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**Table 3: Stream Miles Assessed and Excluded by Major River Basin**

A summary of the number of stream miles in each rotational basin that were excluded and assessed. Stream miles were excluded for four main reasons: they were too deep; they were too close to lake or pond outlets; they were intermittent; or they were located in extensive wetland areas. The pie chart shows the proportion of stream miles that were excluded for each of these reasons. Also shown are the number of assessed stream miles that are fully, partially or non-supporting of Vermont's aquatic life use standards.

# of stream miles	Year					Totals
	2002	2003	2004	2005	2006	
In Basins	1614	1642	933	1502	1584	<b>7275</b>
Excluded	565	328	249	334	458	<b>1934</b>
Assessed	1049	1314	685	1168	1127	<b>5343</b>

Aquatic Life Use Standard	Assessed stream miles
Fully supporting	4702
Partially supporting	267
Non supporting	374



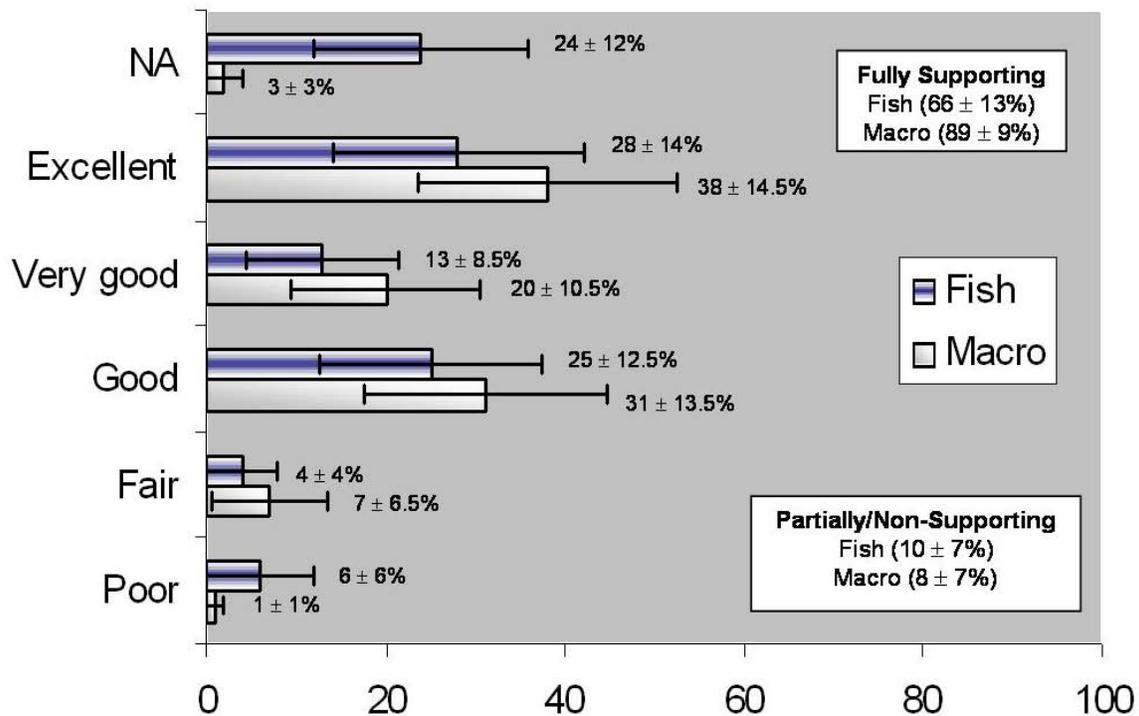
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## COMPARISON OF THE MACROINVERTEBRATE AND FISH DATASETS

When fish and macroinvertebrate datasets are analyzed separately, the macroinvertebrate dataset shows a higher percentage (89%) of stream miles fully supporting ALUS (**Figure 5**). A large percentage (38%) of these stream miles received a biological rating of ‘excellent.’ Only 1% were not supporting ALUS. The fish dataset shows 66% of the assessed stream miles fully supporting ALUS and 6% not supporting ALUS (6%). It also had a much higher percentage (24%) of stream miles not assessed. Biological ratings based on fish results were not assigned at thirteen sites because the site was: a) not sampled; b) the site had too few species to apply the Index of Biotic Integrity; c) the site had a sampling reach that was too short to be adequately representative of the site; or d) the site was a low gradient slow winder and no assessment was possible. One site (North Brook) was not assigned a rating for macroinvertebrate data because it was not preserved properly and could not be assessed.

**Figure 5: Macroinvertebrate versus Fish Assessment Ratings**

A comparison of the percentage of assessed stream length in each biological condition based on macroinvertebrate and fish ratings. Streams in excellent, very good and good condition are fully supporting Vermont’s aquatic life use standards (ALUS), those in fair condition partially support ALUS, and those in poor condition are non-supporting ALUS. NA refers to the percentage of sites that were either not sampled or not assigned a rating. The error bars represent 95% confidence intervals.



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## EXAMINATION OF SITES THAT WERE NON SUPPORTING AQUATIC LIFE USES

Fourteen sites received overall biological ratings of 'fair' or 'poor' (**Table 4**). A closer examination of these sites revealed no obvious stressors at four of the sites. Poor habitat (either naturally occurring or from human alteration) may have been a limiting factor at five of the sites. The biota at one site appeared to be affected by its close proximity to a pond. Two sites appeared to be affected by nutrient runoff, and three sites were likely affected by sedimentation.

The fish communities consistently received lower biological ratings than the macroinvertebrate communities at these sites. At five of the sites, the fish community was assigned a rating of 'fair,' while the macroinvertebrate community received ratings of 'excellent' or 'very good.' At two of the sites where the fish community rated 'poor,' the macroinvertebrate community rated 'good.'

## EXAMINATION OF DIFFERENT STREAM TYPES/HABITATS

Vermont DEC applies different macroinvertebrate "biocriteria" evaluation for four wadeable stream eco-types: small high gradient (mostly first and second order high elevation streams); medium high gradient (mostly 3-4<sup>th</sup> order riffle-dominated streams); warm water moderate gradient (large and small low elevation pool-riffle streams; and low gradient "slow winders" (low elevation warm pool-dominated soft bottom streams). Almost half of the sites (47%) sampled for macroinvertebrates were categorized as small high gradient streams (**Figure 6**). Twenty-nine percent of the sites were categorized as medium high gradient, followed by slow winders (14%) and warm water moderate gradient (10%). Over half of the small and medium high gradient sites received ratings of 'excellent' and 'very good' (**Figure 7a-d**). The warm water moderate gradient sites were the only ones to receive ratings of 'poor,' but it should be noted that this stream type had the smallest sample size (8). Sixty-four percent of the slow winders received ratings of 'good' or 'fair.'

Vermont DEC applies to fish community indexes of biotic integrity, based on stream temperature and size characteristics: cold water (mostly 1-3<sup>rd</sup> order trout streams); and mixed water (larger warmer stream systems with cold and/or warm water species expected). No IBI has been developed for low gradient soft bottom warm water streams. The majority of the sites sampled for fish (48%) had mixed water habitat, while 41% were categorized as cold water habitat (**Figure 8**). Over half (62%) of the cold water sites were assigned a biological rating of 'excellent' or 'very good' (**Figure 9a-b**). Seventeen percent of the cold water sites received a rating of 'fair.' Less than half (41%) of the mixed water sites received a ratings of 'excellent' and 'very good.' The majority of sites (40%) received a rating of 'good,' while 13% of the sites rated 'poor.'

## EXAMINATION OF THE PROXIMITY OF VERMONT'S STREAMS TO ROADS

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The mean distance of randomly selected sites from the closest road was 0.21 miles (**Table 5**). Over half (51%) of the randomly selected sites were within a tenth of a mile of the closest road, and 81% were within a quarter mile of the closest road (**Figure 10**). Only 4% of the sites were more than one mile from the closest road.

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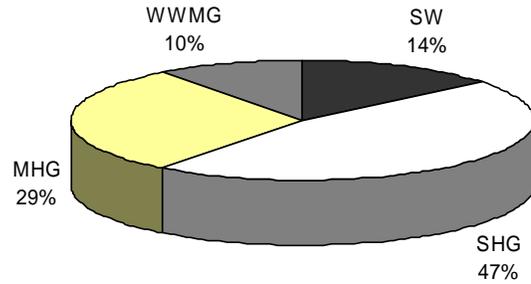
**Table 4: Summary of 14 Sites in Poor/Fair Biological Condition**

A summary of the fourteen sites that did not meet Vermont's aquatic life use standards based on the combined fish/macroinvertebrate dataset, and of the possible stressors affecting these sites.

Site name (River Mile)	Overall Rating	Macro Sampling Date	Macro Rating	Fish Sampling Date	Fish Rating	Possible Stressors
Bresee Mill Brook (4.3)	Fair	10/6/2006	Exc	10/6/2006	Fair	50 meters downstream from large culvert; landowner said that the stream sometimes dries up
Mosher Meadow Brook (0.2)	Fair	9/23/2003	Exc	8/21/2003	Fair	Uncertain
Mt. Tabor Brook (1.9)	Fair	9/4/2003	Exc	7/1/2003	Fair	Within sampling reach, habitat changed from small high gradient stream to slow winder; water chemistry shows site to be moderately sensitive to acidification (alkalinity = 8.2 mg CaCO <sub>3</sub> /L)
Mad River (23.6)	Fair	9/15/2005	Ex- Vgood	9/15/2005	Fair	Uncertain
Bloody Brook (1.6)	Fair	9/13/2006	Vgood	9/13/2006	Fair	Uncertain
Burgess Branch (4.8)	Fair	8/7/2002	Fair	8/7/2002	NA	Physical habitat alteration due to nearby asbestos mine; sedimentation
Lemon Fair River Trib #9 (2.3)	Fair	6/17/2003	Fair	6/7/2003	NA	Uncertain
Potash Brook (2.1)	Fair	9/21/2004	Fair	9/13/2004	NA	Impacted by urbanization
Johns River (1.4)	Poor	8/19/2003	Fair	8/20/2003	Poor	Uncertain
Ompompanoosuc R. (13.6)	Poor	7/11/2002	Fair	7/11/2002	Poor	Located in backwater of old dam; stream is in a state of geomorphic flux; sedimentation
Kent Pond Outlet (0.4)	Poor	9/11/2002	F-Poor	7/30/2002	Poor	Affected by close proximity to pond
First Branch White River (15.7)	Poor	9/13/2006	Good	9/13/2006	Poor	Fish habitat naturally poor
Mill Brook (Fairfax) (10.8)	Poor	10/1/2002	Good	8/5/2002	Poor	Nutrient runoff
Rock River (5.9)	Poor	8/5/2002	Poor	8/5/2002	Fair	Nutrient runoff, sedimentation

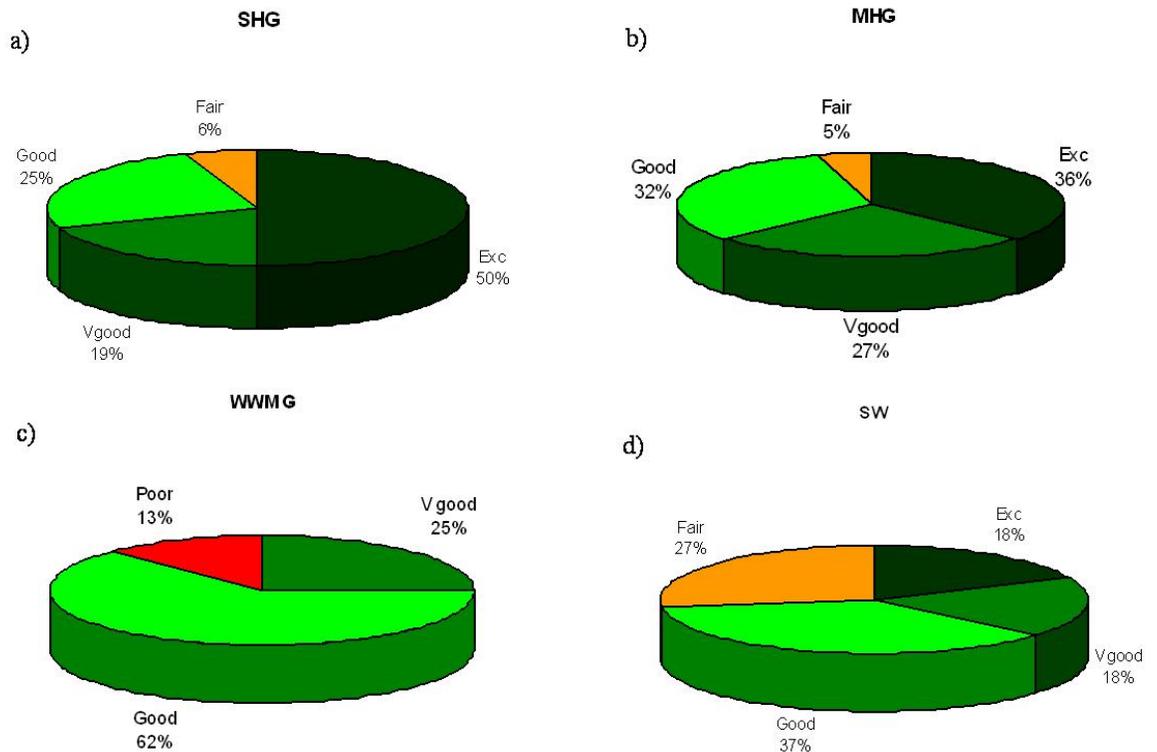
**Figure 6: Percent of Assessed Stream Length by Macroinvertebrate Stream Type**

The percentages of assessed stream length that fall into the four macroinvertebrate stream types. The four types are small high gradient streams (SHG), medium high gradient streams (MHG), warm water moderate gradient streams and rivers (WWMG) and slow winders (SW).



**Figure 7: Macroinvertebrate Condition Rating by Stream Type**

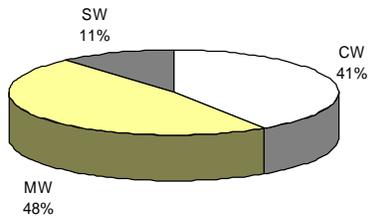
The percentage of sites that received macroinvertebrate ratings of excellent (Exc), very good (Vgood), good, fair and poor for: a) small high gradient streams (n=36); b) medium high gradient streams (n=22); c) warm water moderate gradient streams (n=8); and d) low gradient slow winders (n=11).



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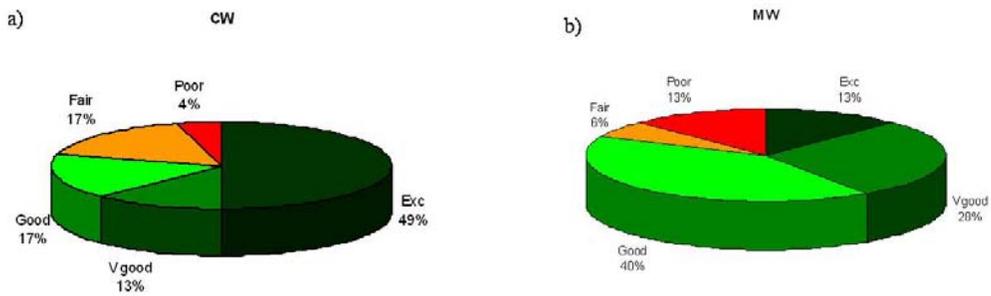
**Figure 8: Percent of Assessed Stream Length by Fish IBI Type**

The percentages of assessed stream length that are considered to be coldwater (CW), mixed water (MW) and slow winder (SW) for fish assemblage evaluation.



**Figure 9: Fish Condition Ratings by IBI Type**

The percentage of sites that received fish ratings of excellent (Exc), very good (Vgood), good, fair and poor for: a) coldwater streams (n=24); and b) mixed water streams (n=32).



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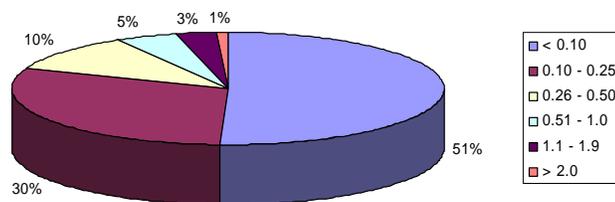
**Table 5: Site Distance from Roads**

The mean, minimum and maximum distance of all potential sites from the closest road (this includes Class Four and Forest Service roads). See Appendix 2 for more details.

Miles	Distance from closest road
0.21	mean
0.01	minimum
2.5	maximum

**Figure 10: Site Distance from Roads**

The percentage of randomly selected sites that were within a certain distance (in miles) of the closest roads.

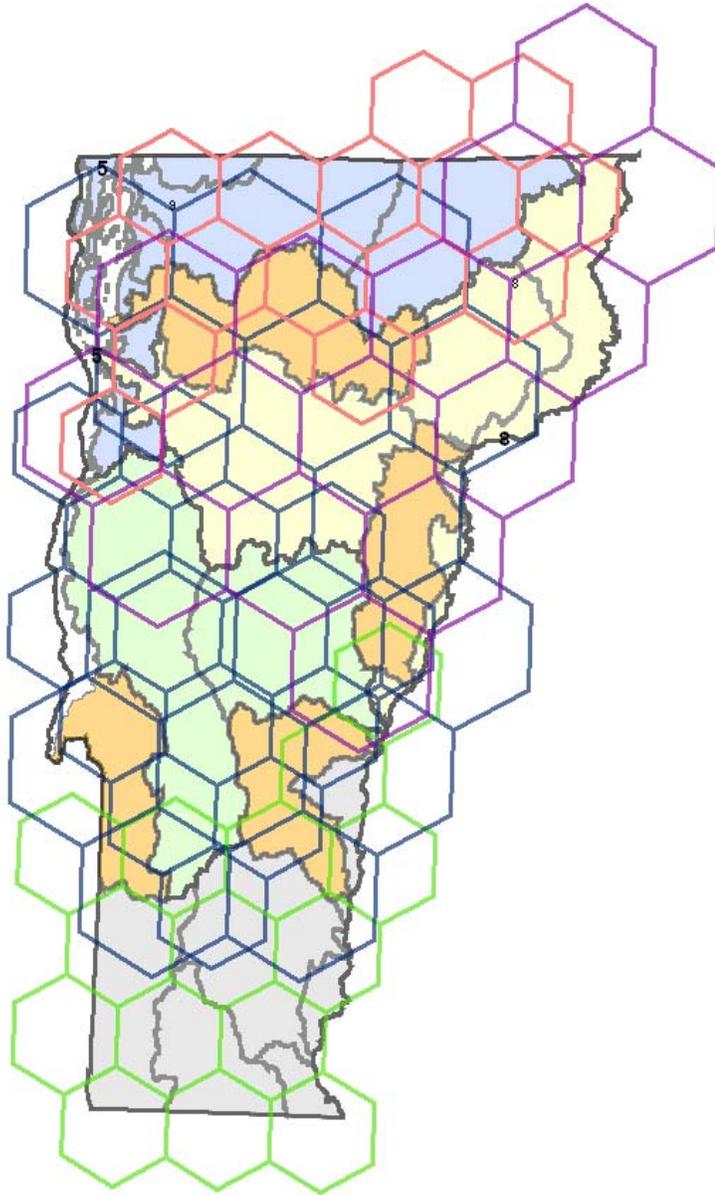


## ALTERNATE ANALYSIS

The use of multiple layers of hexagons across the five rotational watershed areas created some logistical problems and introduced some potential bias in determining weighting factors for hexagons with small proportional watershed inclusion. An alternative analysis was evaluated in order to address some of the difficulties associated with the hexagon study design. The Thiessen polygon design is demonstrated in figures and table below.

**Figure 11: All Five Hex Overlays Together**

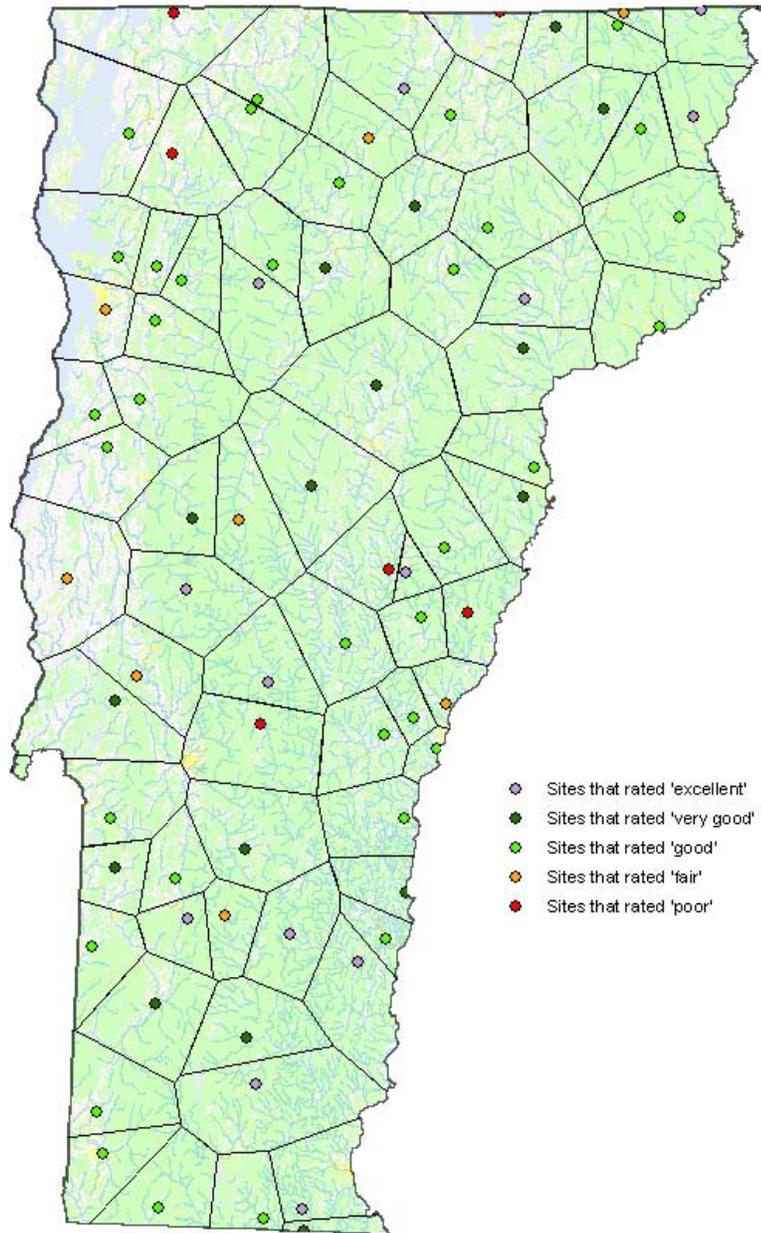
This is what it looks like when the hexagon overlays from each of the five years are placed on the same map. The hexagons from different years overlap, so it was initially thought that total site weightings could not be calculated using the hexagons. However, upon closer examination, it was revealed that although the hexagons overlap, the stream layers do *not*. Therefore the hexagons could be used to calculate final site weights. However, we went ahead with an alternate way to calculate site weights to satisfy our curiosity. Upon the recommendation of Hal Walker, we used Thiessen polygons.



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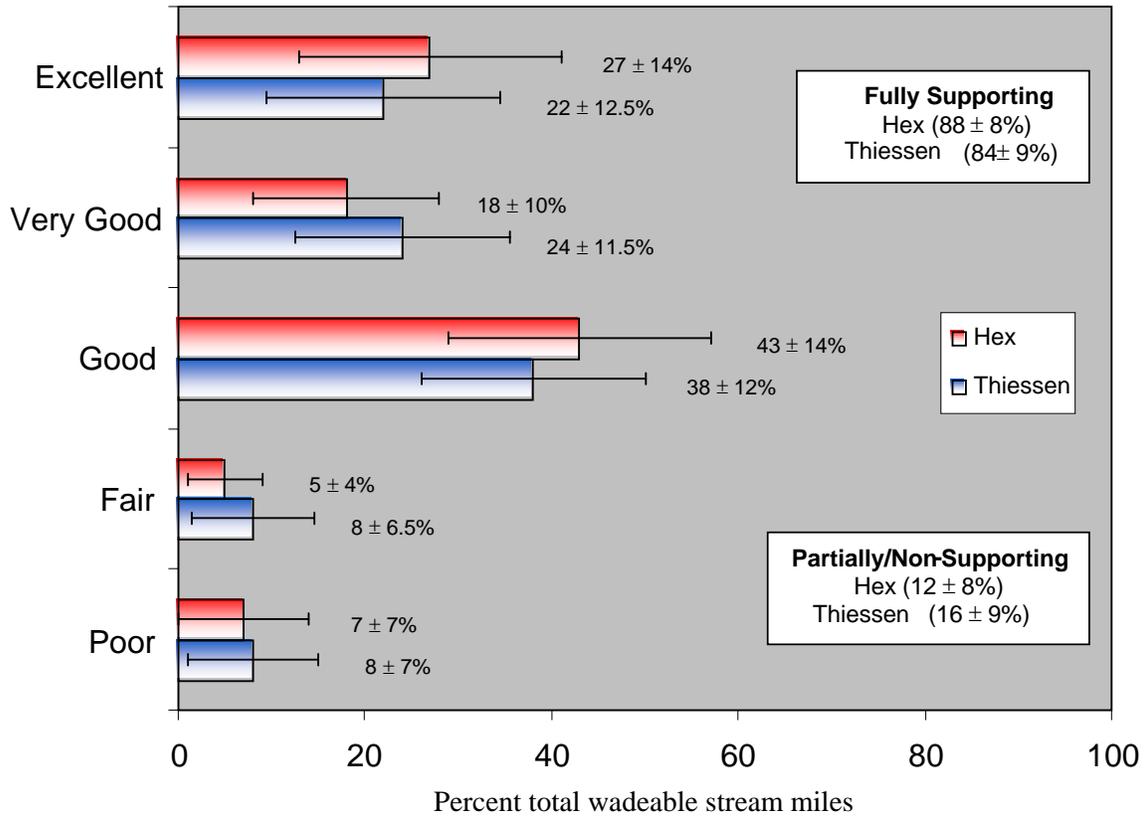
## Figure 12: Thiessen Polygons

ArcGIS was used to draw Thiessen polygons around each of the seventy-eight sampling points. In Thiessen polygons, any location within a polygon is closer to its associated point than to the point of any other polygon.



**Figure 13: Thiessen Polygon vs. Rotational Hex Results**

A comparison of the rotational hex survey results (% wadeable stream miles in use support category) when site weights were derived from the original hex overlays versus Thiessen polygons.



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**Table 6: Polygon Weighting Factors - Hex vs. Thiessen**

A summary of the site weights derived from hexagons and Thiessen polygons. Overall assessments were derived from the combined macroinvertebrate/fish dataset.

Total stream miles in Hex	Hex Weight	Site name (RM)	Stream Miles in Polygon	Thiessen Weight	Overall Assessment
298.24	0.0410	Green River Trib #4 (1.7)	151.11	0.0208	Excellent
264.58	0.0364	Ranch Brook (1.5)	100.66	0.0138	Excellent
239.24	0.0329	Williams River Trib #11 (0.4)	209.95	0.0289	Excellent
212.54	0.0292	Bartlett Brook (1.2)	136.01	0.0187	Excellent
190.86	0.0262	Goshen Bk. Trib #2 (0.2)	137.26	0.0189	Excellent
178.04	0.0245	North Brook (0.4)	129.95	0.0179	Excellent
154.71	0.0213	Andover Branch (4.8)	171.48	0.0236	Excellent
133.48	0.0183	Mineral Spring Brook (0.2)	116.06	0.0160	Excellent
108.72	0.0149	Wardsboro Bk. Trib #5 (3.9)	281.79	0.0387	Excellent
94.74	0.0130	Jenkins (2.6)	26.38	0.0036	Excellent
63.22	0.0087	E Branch Nulhegan River (2.9)	67.37	0.0093	Excellent
22.27	0.0031	McGinn Brook (0.7)	40.82	0.0056	Excellent
2.81	0.0004	Morrill Brook (0.1)	49.44	0.0068	Excellent
<b>1963.45</b>	<b>0.27</b>		<b>1618.28</b>	<b>0.22</b>	<b>Excellent</b>
216.29	0.0297	Sodom Pond Brook (3.9)	227.39	0.0313	Very Good
154.39	0.0212	Ryder Bk (trib 5) (0.8)	110.70	0.0152	Very Good
137.54	0.0189	Sunny Brook (0.3)	162.27	0.0223	Very Good
137.32	0.0189	Stearns Brook (2.3)	48.49	0.0067	Very Good
111.41	0.0153	Batten Kill (48.0)	106.23	0.0146	Very Good
108.72	0.0149	N. Branch Ball Mtn Brook (0.4)	137.95	0.0190	Very Good
87.06	0.0120	New Haven River (20.9)	74.67	0.0103	Very Good
65.85	0.0091	Joe's Brook (6.3)	95.68	0.0132	Very Good
65.36	0.0090	Blood Brook (0.1)	116.02	0.0159	Very Good
62.89	0.0086	Green River (13.8)	34.19	0.0047	Very Good
56.13	0.0077	Peach Brook (4.2)	74.94	0.0103	Very Good
49.31	0.0068	Wells Brook (5.5)	33.34	0.0046	Very Good
40.65	0.0056	Mill Brook Trib (3.1)	177.40	0.0244	Very Good
27.01	0.0037	Pherrins River (1.9)	93.43	0.0128	Very Good
11.20	0.0015	Black River - Craftsbury (30.5)	84.61	0.0116	Very Good
8.26	0.0011	Giddings Brook (2.4)	108.62	0.0149	Very Good
<b>1339.38</b>	<b>0.18</b>		<b>1685.92</b>	<b>0.24</b>	<b>Very Good</b>
304.46	0.0418	Second Branch White River (0.3)	189.45	0.0260	Good
196.81	0.0271	Granby Stream (2.9)	134.19	0.0184	Good
190.82	0.0262	Seavers Brook (0.1)	91.41	0.0126	Good
162.10	0.0223	South Stream (Jewett Brook) (0.1)	74.93	0.0103	Good
161.35	0.0222	Gihon River (10.3)	90.05	0.0124	Good
151.47	0.0208	Little Otter Creek (7.0)	71.89	0.0099	Good
149.48	0.0205	The Branch (1.0)	121.75	0.0167	Good
142.18	0.0195	Poultney River (30.9)	94.89	0.0130	Good
134.93	0.0185	Hubbard Brook (4.0)	169.35	0.0233	Good
124.21	0.0171	Brighton Brook (0.9)	117.92	0.0162	Good
120.60	0.0166	Browns R. (20.4)	59.64	0.0082	Good
119.21	0.0164	Baker Brook (1.2)	50.31	0.0069	Good
102.83	0.0141	Jericho Brook (0.1)	52.87	0.0073	Good

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Total stream miles in Hex	Hex Weight	Site name (RM)	Stream Miles in Polygon	Thiessen Weight	Overall Assessment
101.95	0.0140	Whitman Bk. Trib #1 (1.3)	112.86	0.0155	Good
90.22	0.0124	Meadow Brook (4.4)	108.22	0.0149	Good
90.22	0.0124	Wells River Trib 3# (0.8)	62.08	0.0085	Good
80.31	0.0110	Nulhegan River (15.1)	55.60	0.0076	Good
70.96	0.0098	Old City Brook (0.2)	66.08	0.0091	Good
69.64	0.0096	East Branch North River (14.4)	60.19	0.0083	Good
65.85	0.0091	Miles Stream (0.6)	73.68	0.0101	Good
58.78	0.0081	Lamoille River (76.8)	91.51	0.0126	Good
54.82	0.0075	Beaver Meadow Brook (2.0)	63.26	0.0087	Good
47.13	0.0065	Morrison Bk. (0.9)	114.63	0.0158	Good
42.56	0.0059	N. Br. Hoosic River (8.1)	77.69	0.0107	Good
38.08	0.0052	Lewis Creek (13.9)	96.27	0.0132	Good
35.65	0.0049	Sutton Brook (0.4)	41.50	0.0057	Good
35.53	0.0049	Allen Brook (8.2)	51.03	0.0070	Good
34.15	0.0047	Indian Brook (3.1)	55.06	0.0076	Good
33.43	0.0046	Paran Creek (3.1)	81.12	0.0112	Good
29.04	0.0040	Mill River - Georgia (0.7)	38.72	0.0053	Good
21.60	0.0030	Pinnacle (1.3)	57.26	0.0079	Good
15.67	0.0022	Alder Brook (4.1)	38.16	0.0052	Good
13.85	0.0019	Lewis Creek (4.1)	25.29	0.0035	Good
8.21	0.0011	Kilburn Brook (0.6)	32.79	0.0045	Good
1.28	0.0002	Mill Brook - Rupert (2.8)	39.26	0.0054	Good
<b>3099.39</b>	<b>0.43</b>		<b>2760.90</b>	<b>0.38</b>	<b>Good</b>
86.57	0.0119	Lemon Fair River Trib #9 (2.3)	132.38	0.0182	Fair
57.45	0.0079	Bloody Brook (1.6)	59.56	0.0082	Fair
56.10	0.0077	Burgess Branch (4.8)	66.60	0.0092	Fair
43.82	0.0060	Mad River (23.6)	129.30	0.0178	Fair
40.33	0.0055	Mt. Tabor Brook (1.9)	64.47	0.0089	Fair
31.30	0.0043	Potash Brook (2.1)	28.60	0.0039	Fair
30.29	0.0042	Bresee Mill Brook (4.3)	104.94	0.0144	Fair
3.88	0.0005	Mosher Meadow Brook (0.2)	19.37	0.0027	Fair
<b>349.73</b>	<b>0.05</b>		<b>605.22</b>	<b>0.08</b>	<b>Fair</b>
190.39	0.0262	Kent Pond Outlet (0.4)	181.80	0.0250	Poor
117.26	0.0161	Ompompanoosuc R. (13.6)	106.71	0.0147	Poor
104.55	0.0144	Rock River (5.9)	77.08	0.0106	Poor
89.85	0.0124	First Branch White River (15.7)	122.93	0.0169	Poor
19.84	0.0027	Mill Brook (Fairfax) (10.8)	76.06	0.0105	Poor
2.04	0.0003	Johns River (1.4)	39.77	0.0055	Poor
<b>523.93</b>	<b>0.07</b>		<b>604.35</b>	<b>0.08</b>	<b>Poor</b>

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## DISCUSSION

The implementation of this five year rotational probability project was successful on several administrative and technical fronts.

By designing a five year project that was consistent with existing monitoring and assessment strategies employed by Vermont DEC (i.e. rotational watershed monitoring), the workload associated with the project was spread out over five years. By doing this, VTDEC was able to conduct the necessary sampling without undue reallocation of limited resources away from targeted monitoring and assessment activities critical to the overall implementation of water quality management programs across VTDEC. VTDEC believes that such an effort can be continued in a sustainable manner with mutual benefit to both CWA comprehensive assessment reporting needs and VTDEC water quality management needs. The five year, fifteen site/year effort can likely be sustained with existing resources and provides a preferable alternative to diverting limited resources to a single year effort.

This project demonstrates the potential for utilizing monitoring data from different aquatic communities (fish and macroinvertebrates) and methodologies (VTDEC, NEWS) to arrive at consistent assessment conclusions derived from Biocondition Gradient (BCD) theory in the context of tiered aquatic life uses, as articulated in the Vermont Water Quality Standards. The NEWS project (Davies 2005) has demonstrated the potential of using these results on a regional scale where other states and agencies are applying the same BCG principles to arrive at comparable assessment conclusions.

This project was the result of successful collaborations with US EPA (e.g. project design, site selection, data analysis, mapping, general encouragement and support), GIS/IT staff from the Vermont Agency of Natural Resources and VTDEC biologists and technical staff. Collaborative resources were directed in a manner that allowed for the implementation of a probability based comprehensive assessment consistent with CWA goals and at the same time supported and provided assistance to VTDEC monitoring and assessment efforts related to non-probability water quality management objectives.

In many instances, site condition assessments based on fish and macroinvertebrates arrived at differing conclusions. In our analysis, we chose to base the overall site assessment on whichever community showed the most degraded condition on the presumption that fish and macroinvertebrate communities respond differently to different stressors. These findings are consistent with the larger VTDEC monitoring and assessment data base. In most cases, differences between community assessments are relatively minor, however in some instances the differences are extreme: e.g. macroinvertebrates are excellent and fish are poor. The reasons for these differences have not been addressed in any detail here although it is likely that habitat scale (macro for fish vs. micro for macroinvertebrates) is a significant component. Further evaluation of larger data sets would provide greater insight into the differences and their significance to overall site assessments.

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The hexagon overlay study design created some logistical problems and appears to introduce some potential bias in regards to determining weighting factors for sites that represent only a small proportion of the rotational watershed being assessed. The alternative analysis presented here based on Thiessen polygons appears to represent the best design alternative for future assessments.

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VT DEC. 2006. Water Quality Division Field Methods Manual. Waterbury, VT.

# DRAFT 030508

## Appendix 1.

Hex/site weights.

Total stream miles in Hex	Hex Weight	Site name (RM)	Overall Rating
298.24	0.0410	Green River Trib #4 (1.7)	Excellent
264.58	0.0364	Ranch Brook (1.5)	Excellent
239.24	0.0329	Williams River Trib #11 (0.4)	Excellent
212.54	0.0292	Bartlett Brook (1.2)	Excellent
190.86	0.0262	Goshen Bk. Trib #2 (0.2)	Excellent
178.04	0.0245	North Brook (0.4)	Excellent
154.71	0.0213	Andover Branch (4.8)	Excellent
133.48	0.0183	Mineral Spring Brook (0.2)	Excellent
108.72	0.0149	Wardsboro Bk. Trib #5 (3.9)	Excellent
94.74	0.0130	Jenkins (2.6)	Excellent
63.22	0.0087	E Branch Nulhegan River (2.9)	Excellent
22.27	0.0031	McGinn Brook (0.7)	Excellent
2.81	0.0004	Morrill Brook (0.1)	Excellent
<b>1963.45</b>	<b>0.27</b>	<b>Total</b>	<b>Excellent</b>
216.29	0.0297	Sodom Pond Brook (3.9)	Very Good
154.39	0.0212	Ryder Bk (trib 5) (0.8)	Very Good
137.54	0.0189	Sunny Brook (0.3)	Very Good
137.32	0.0189	Stearns Brook (2.3)	Very Good
111.41	0.0153	Batten Kill (48.0)	Very Good
108.72	0.0149	N. Branch Ball Mtn Brook (0.4)	Very Good
87.06	0.0120	New Haven River (20.9)	Very Good
65.85	0.0091	Joe's Brook (6.3)	Very Good
65.36	0.0090	Blood Brook (0.1)	Very Good
62.89	0.0086	Green River (13.8)	Very Good
56.13	0.0077	Peach Brook (4.2)	Very Good
49.31	0.0068	Wells Brook (5.5)	Very Good
40.65	0.0056	Mill Brook Trib (3.1)	Very Good
27.01	0.0037	Pherrins River (1.9)	Very Good
11.20	0.0015	Black River - Craftsbury (30.5)	Very Good
8.26	0.0011	Giddings Brook (2.4)	Very Good
<b>1339.38</b>	<b>0.18</b>	<b>Total</b>	<b>Very Good</b>
304.46	0.0418	Second Branch White River (0.3)	Good
196.81	0.0271	Granby Stream (2.9)	Good
190.82	0.0262	Seavers Brook (0.1)	Good
162.10	0.0223	South Stream (Jewett Brook) (0.1)	Good
161.35	0.0222	Gihon River (10.3)	Good
151.47	0.0208	Little Otter Creek (7.0)	Good
149.48	0.0205	The Branch (1.0)	Good
142.18	0.0195	Poultney River (30.9)	Good
134.93	0.0185	Hubbard Brook (4.0)	Good
124.21	0.0171	Brighton Brook (0.9)	Good
120.60	0.0166	Browns R. (20.4)	Good
119.21	0.0164	Baker Brook (1.2)	Good
102.83	0.0141	Jericho Brook (0.1)	Good
101.95	0.0140	Whitman Bk. Trib #1 (1.3)	Good
90.22	0.0124	Meadow Brook (4.4)	Good
90.22	0.0124	Wells River Trib 3# (0.8)	Good

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## Hex/Site Weights continued...

Total stream miles in Hex	Hex Weight	Site name (RM)	Overall Assessment
80.31	0.0110	Nulhegan River (15.1)	Good
70.96	0.0098	Old City Brook (0.2)	Good
69.64	0.0096	East Branch North River (14.4)	Good
65.85	0.0091	Miles Stream (0.6)	Good
58.78	0.0081	Lamoille River (76.8)	Good
54.82	0.0075	Beaver Meadow Brook (2.0)	Good
47.13	0.0065	Morrison Bk. (0.9)	Good
42.56	0.0059	N. Br. Hoosic River (8.1)	Good
38.08	0.0052	Lewis Creek (13.9)	Good
35.65	0.0049	Sutton Brook (0.4)	Good
35.53	0.0049	Allen Brook (8.2)	Good
34.15	0.0047	Indian Brook (3.1)	Good
33.43	0.0046	Paran Creek (3.1)	Good
29.04	0.0040	Mill River - Georgia (0.7)	Good
21.60	0.0030	Pinnacle (1.3)	Good
15.67	0.0022	Alder Brook (4.1)	Good
13.85	0.0019	Lewis Creek (4.1)	Good
8.21	0.0011	Kilburn Brook (0.6)	Good
1.28	0.0002	Mill Brook - Rupert (2.8)	Good
<b>3099.39</b>	<b>0.43</b>	<b>Total</b>	<b>Good</b>
86.57	0.0119	Lemon Fair River Trib #9 (2.3)	Fair
57.45	0.0079	Bloody Brook (1.6)	Fair
56.10	0.0077	Burgess Branch (4.8)	Fair
43.82	0.0060	Mad River (23.6)	Fair
40.33	0.0055	Mt. Tabor Brook (1.9)	Fair
31.30	0.0043	Potash Brook (2.1)	Fair
30.29	0.0042	Bresee Mill Brook (4.3)	Fair
3.88	0.0005	Mosher Meadow Brook (0.2)	Fair
<b>349.73</b>	<b>0.05</b>	<b>Total</b>	<b>Fair</b>
190.39	0.0262	Kent Pond Outlet (0.4)	Poor
117.26	0.0161	Ompompanoosuc R. (13.6)	Poor
104.55	0.0144	Rock River (5.9)	Poor
89.85	0.0124	First Branch White River (15.7)	Poor
19.84	0.0027	Mill Brook (Fairfax) (10.8)	Poor
2.04	0.0003	Johns River (1.4)	Poor
<b>523.93</b>	<b>0.07</b>	<b>Total</b>	<b>Poor</b>
<b>7275</b>	<b>1.0000</b>	<b>Totals</b>	

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## Appendix 2

Lists of the hex picks (**bold sites sampled**) for 2002-2006 and notes on site elimination.

### 2002 Vermont Sampling Stations

Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-73.088385	43.261058	Mettawee River	1	Regional Station		
<b>-73.15912</b>	<b>43.40927</b>	<b>Wells Brook</b>	<b>1</b>	<b>1</b>		0.05
-73.09601	43.36855	Flower Brook	1	2		0.04
-73.11215	43.29386	Unnamed Trib to Mettawee River	1	3		0.2
-72.45887	43.28066	Unnamed Trib to Black River	2	1	between ponds/dams	0.2
-72.65261	43.42894	Twentymile Stream	2	2		0.03
<b>-72.46767</b>	<b>43.27926</b>	<b>Seavers Brook</b>	<b>2</b>	<b>3</b>		0.01
-73.33819	43.6721	Cogman Creek	3	1		0.2
<b>-73.17423</b>	<b>43.50048</b>	<b>Poultney River</b>	<b>3</b>	<b>2</b>		0.04
-73.12039	43.4753	South Brook	3	3		0.03
-72.79918	43.62883	Roaring Brook	4	1		0.6
-72.68419	43.62259	Washburn Brook	4	2		0.2
-72.75006	43.47269	Unnamed Trib to Patch Brook	4	3	lake outlet	0.1
<b>-72.79117</b>	<b>43.67838</b>	<b>Kent Pond Outlet</b>	<b>4</b>	<b>1b</b>		0.1
-72.48061	43.67968	Unnamed Trib to Ottauquechee River	5	1	looks intermittent	0.7
-72.48791	43.41563	Unnamed Trib to North Branch Black River	5	2	strange - no stream shows up on topo map	0.13
-72.47058	43.63601	Ottawquechee River	5	3	too deep?	0.02
<b>-72.47342</b>	<b>43.65986</b>	<b>Trib to Whitman Bk.</b>	<b>5</b>	<b>1b</b>		0.1
-73.22796	43.74336	Hubbardton River	6	1	lake outlet	0.01
<b>-73.16195</b>	<b>43.71948</b>	<b>Giddings Brook</b>	<b>6</b>	<b>2</b>		0.24
-73.23851	43.76141	Unnamed Trib to Hubbardton River	6	3	wetlands, small first order	0.24
-72.59778	43.6824	Gulf Stream	7	1		0.03
-72.34771	43.9382	Old City Brook	7	2	wetland	0.02
<b>-72.37907</b>	<b>43.87688</b>	<b>Old City Brook</b>	<b>7</b>	<b>3</b>		0.05
-72.27705	43.88091	Unnamed Trib to Ompompanoosuc River	8	1	looks intermittent	0.9
<b>-72.25854</b>	<b>43.88554</b>	<b>Ompompanoosuc River</b>	<b>8</b>	<b>2</b>		0.05
-72.31393	43.86775	Unnamed Trib to Abbott Brook	8	3		0.01
<b>-72.31698</b>	<b>44.00671</b>	<b>Meadow Brook</b>	<b>9</b>	<b>1</b>		0.16
<b>-72.08728</b>	<b>44.15508</b>	<b>Unnamed Trib to Wells River</b>	<b>9</b>	<b>2</b>		0.01
-72.23296	44.11636	Unnamed Trib to Tabor Branch	9	3		0.01

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Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-72.96214	44.50962	Unnamed Trib to Lee River	10	1	looks intermittent	0.05
<b>-72.99923</b>	<b>44.50486</b>	<b>Browns River</b>	<b>10</b>	<b>2</b>		0.02
-72.95278	44.52066	The Creek	10	3		0.08
<b>-72.62519</b>	<b>44.52761</b>	<b>Unnamed Trib to Ryder Brook</b>	<b>11</b>	<b>1</b>		0.13
-72.40976	44.54506	Millard Brook	11	2	small first order, looks intermittent on ortho map	0.16
-72.65574	44.61058	Lamoille River	11	3		0.15
<b>-72.29265</b>	<b>44.52382</b>	<b>Lamoille River</b>	<b>12</b>	<b>1</b>		0.07
-72.20328	44.52896	Unnamed Trib to Stannard Brook	12	2	looks intermittent	0.33
-72.28354	44.52718	Lamoille River	12	3		0.11
-73.15908	44.67385	Streeter Brook (Trib)	13	1	wetland	0.18
-73.03007	44.68975	Swift Brook	13	2		0.13
-73.04542	44.72098	Beaver Meadow Brook	13	3		0.13
<b>-73.02729</b>	<b>44.74015</b>	<b>Mill Brook Fairfax</b>	<b>13</b>	<b>3b</b>		0.1
-72.61882	44.72285	Stony Brook	14	1	looks intermittent	2.4
-73.02655	44.69938	Swift Brook	14	2		0.28
-72.77831	44.66855	Lamoille River	14	3	too deep?	0.14
<b>-72.5888</b>	<b>44.68535</b>	<b>Gihon River</b>	<b>14</b>	<b>2b</b>		0.05
-72.23504	44.64077	Mud Pond Brook	15	1	wetland	1.4
-72.48293	44.68315	Wiley Brook	15	2	looks intermittent	0.3
<b>-72.2018</b>	<b>44.60266</b>	<b>Morrison Brook</b>	<b>15</b>	<b>3</b>		0.3

Summary-2002		average	0.22
49	# of possible picks	min	0.01
0.35	proportion not in target population	max	2.4
1613.7	stream miles in basin		
564.8	stream miles excluded		
1048.9	stream miles assessed		
17	# sites excluded		
4	wetland		
8	intermittent/tough to access		
3	lake/pond outlet - Lk Hortonia, etc.		
2	too deep - Lamoille and Ottaquechee		

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## Vermont 2003 Sampling Stations

Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-73.23767	42.76226	Ladd Brook	1	1		0.22
<b>-73.04531</b>	<b>42.77824</b>	<b>North Branch Hoosic River</b>	<b>1</b>	<b>2</b>		0.04
-73.18179	42.81516	South Stream	1	3	wetland	0.18
<b>-72.78023</b>	<b>42.75703</b>	<b>East Branch North River RM. 14.4</b>	<b>2</b>	<b>1</b>		0.27
-72.72716	42.73898	East Branch North River	2	2		0.03
-72.88366	42.78809	Unnamed bet.Sadawga Pd. and Harriman Res.	2	3	lake outlet	0.03
<b>-72.67601</b>	<b>42.73383</b>	<b>Green River</b>	<b>3</b>	<b>1</b>		0.06
-72.58754	42.74726	West Brook	3	2	looks intermittent	0.06
-72.56568	42.81424	Broad Brook	3	3		0.01
<b>-73.20047</b>	<b>42.95424</b>	<b>Paran Creek</b>	<b>4</b>	<b>1</b>		0.13
-73.25088	42.91174	Walloomsac River	4	2		0.05
-73.26592	42.82952	Porter Hollow Brook	4	3		0.2
<b>-73.18609</b>	<b>42.87653</b>	<b>Jewett Brook = South Stream</b>	<b>5</b>	<b>1</b>		0.03
-72.94621	42.91891	East Branch Deerfield River	5	2		0.5
-72.97356	42.92559	Deerfield River	5	3		0.02
-72.66674	43.00032	Smith Brook	6	1	looks intermittent	0.18
<b>-72.68071</b>	<b>42.77379</b>	<b>Unnamed trib to Green River</b>	<b>6</b>	<b>2</b>		0.02
-72.63114	43.0262	Unnamed trib to Grassy Brook	6	3	looks intermittent	0.35
<b>-73.05449</b>	<b>43.15774</b>	<b>Batten Kill</b>	<b>7</b>	<b>1</b>		0.12
-73.08347	43.12116	Batten Kill	7	2		0.2
-73.14182	43.06624	Warm Brook	7	3		0.05
<b>-72.80041</b>	<b>43.00695</b>	<b>Unnamed trib to Wardsboro Brook</b>	<b>8</b>	<b>1</b>		0.03
<b>-72.82415</b>	<b>43.09353</b>	<b>North Branch Ball Mt. Brook</b>	<b>8</b>	<b>2</b>		0.06
-72.89435	43.19947	Eddy Brook	8	3		0.42
<b>-72.53991</b>	<b>43.23453</b>	<b>Unnamed trib to Williams River</b>	<b>9</b>	<b>1</b>		0.02
-72.53121	43.13726	Saxtons River	9	2		0.09
-72.44587	43.21807	Commissary Brook	9	3		0.3

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Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
<b>-73.21576</b>	<b>43.2625</b>	<b>Mill Brook</b>	<b>10</b>	<b>1</b>		0.06
-73.21159	43.26405	Mill Brook	10	2		0.04
-73.19036	43.27349	Mill Brook	10	3		0.02
<b>-72.87958</b>	<b>43.32177</b>	<b>Mt Tabor Brook</b>	<b>11</b>	<b>1</b>		0.04
-72.98421	43.23198	Little Mad Tom Brook	11	2	looks intermittent	1.4
-73.00865	43.24688	Batten Kill Trib	11	3	looks intermittent	0.03
<b>-72.71451</b>	<b>43.28638</b>	<b>Andover Branch</b>	<b>12</b>	<b>1</b>		0.01
-72.65935	43.23991	Unnamed trib to So. Br. Williams River	12	2	too close to pond outlet	0.03
-72.70523	43.25844	Middle Branch Williams River	12	3		0.01
-72.39618	43.43784	Unnamed trib to Connecticut River	13	1		0.04
-72.43036	43.29567	Spencer Brook	13	2		0.07
<b>-72.41816</b>	<b>43.36452</b>	<b>Blood Brook</b>	<b>13</b>	<b>3</b>		0.11
-72.48289	43.49975	Unnamed trib to Beaver Brook	14	1		0.01
<b>-72.4227</b>	<b>43.50408</b>	<b>Hubbard Brook</b>	<b>14</b>	<b>2</b>		0.03
-72.44807	43.47096	Mill Brook	14	3		0.04
-72.35444	43.64707	Unnamed trib to White River	15	1		0.05
<b>-72.34021</b>	<b>43.6315</b>	<b>Kilburn Brook</b>	<b>15</b>	<b>2</b>		0.01
-72.36682	43.64282	Unnamed trib to Kilburn Brook	15	3	too close to reservoir	0.3

Summary						
2003					average	0.13
45	potential picks				min	0.01
0.2	proportion excluded				max	1.4
1642	stream miles in basin					
0	stream miles excluded					
1642	stream miles assessed					
9	# sites excluded					
1	wetland					
3	lake/pond outlet					
5	intermittent					

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## Vermont 2004 Sampling Stations

Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-73.21531	44.32011	Mud Hollow Brook	1	1		0.22
<b>-73.19456</b>	<b>44.44752</b>	<b>Potash Brook</b>	<b>1</b>	<b>2</b>		0.14
-73.20866	44.3075	Unnamed trib to Bingham Brook	1	3		0.17
<b>-73.16345</b>	<b>44.54559</b>	<b>Indian Brook</b>	<b>2</b>	<b>1</b>		0.06
-73.10233	44.50112	Unnamed trib to Indian Brook	2	2	too close to Colchester Pond	0.26
-73.13457	44.54804	Pond Brook	2	3	wetland	0.5
<b>-72.39174</b>	<b>44.64351</b>	<b>Black River (Craftsbury)</b>	<b>3</b>	<b>1</b>		0.44
-72.33599	44.60865	Webber Brook	3	2		0.05
-72.3583	44.58842	Adler Brook	3	3	too close to Lk Eligo	0.03
-73.0801	44.75902	Unnamed trib to Mill River	4	1		0.16
<b>-73.13751</b>	<b>44.77531</b>	<b>Mill River</b>	<b>4</b>	<b>2</b>		0.25
-73.10299	44.80277	Rugg Brook	4	3		0.05
-72.859388	44.78311	Black Creek	5	Regional Station		
<b>-72.8189</b>	<b>44.82409</b>	<b>Beaver Meadow Brook</b>	<b>5</b>	<b>1</b>		0.01
-72.87152	44.79007	Black Creek	5	2		0.1
-72.79072	44.79733	The Branch	5	3		0.15
<b>-72.51448</b>	<b>44.77098</b>	<b>Burgess Branch</b>	<b>6</b>	<b>1</b>		0.18
-72.40821	44.72515	Rogers Branch	6	2		0.9
-72.38148	44.74756	McCleary Brook	6	3		0.05
<b>-72.3007</b>	<b>44.81305</b>	<b>Unnamed trib to Black River - Brighton Brook</b>	<b>7</b>	<b>1</b>		0.01
-72.36498	44.74186	Black River (Albany)	7	2		0.06
-72.1438	44.82069	Brownington Branch	7	3		0.1
<b>-71.89924</b>	<b>44.823</b>	<b>Pherrins River</b>	<b>8</b>	<b>1</b>		0.12
-71.90359	44.76941	Oswegatchie Brook	8	2		0.02
-71.94875	44.77387	Unnamed trib to Cold Brook	8	3	too close to Mud Pond	0.07
<b>-73.02483</b>	<b>45.0001</b>	<b>Rock River</b>	<b>9</b>	<b>1</b>		0.07
-73.06509	45.00945	Rock River	9	2		0.24
-72.92677	44.91435	McGowen Brook	9	3		0.5
-72.84401	45.00778	Sisco Brook	10	1	looks intermittent	0.14
<b>-72.80592</b>	<b>44.84082</b>	<b>Beaver Meadow Brook = The Branch</b>	<b>10</b>	<b>2</b>		0.02
-72.77745	44.94663	Trout Brook	10	3		0.3

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Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-72.41907	44.86226	<b>Mineral Spring Brook</b>	11	1		0.12
-72.41911	44.92618	Bugbee Brook	11	2	looks intermittent	0.28
-72.49125	44.878	Taft Brook	11	3		0.35
-72.0617	44.822801	Brownington Branch	12	Regional Station	NEWS 2001	
-72.04146	44.8557	Clyde River	12	1	wetland, between ponds	0.35
-72.02246	44.97534	<b>Stearns Brook</b>	12	2		0.11
-71.8755	44.92067	Pherrins River	12	3	too close to Norton Pond	0.22
-71.77251	45.00197	Unnamed trib to Coaticook River	13	1	wetland	0.22
-71.86221	44.97664	<b>Sutton Brook</b>	13	2	sampled site was about 1.5 miles from assigned site - accessibility issue. No significant land use differences between assigned and sampled sites.	1.9
-71.72625	44.99579	Averill Creek	13	3	too close to Great Averill Pond	0.06
-72.18862	45.00335	Unnamed trib to Lake Memphremagog	14	1	wetland	0.28
-72.19692	44.99839	Unnamed trib to Lake Memphremagog	14	2	too close to Lk Memph	0.01
-72.16903	45.00372	<b>Johns River</b>	14	3	0.2 miles from assigned site.	0.01
-71.84596	44.99939	<b>Mosher Meadow Brook</b>	15	1	sampled site was 1.5 miles from assigned site - accessibility issue. No significant land use differences between assigned and sampled sites.	1.7
-71.79723	45.00966	Coaticook River	15	2		0.02
-71.84958	45.00148	Mosher Meadow Brook	15	3		1.9

Summary 2004		<b>average</b>	0.29
45	potential picks	<b>min</b>	0.01
0.27	proportion excluded	<b>max</b>	1.90
934	stream miles in basin		
249	stream miles excluded		
685	stream miles assessed		
12	# sites excluded		
4	wetland		
7	lake/pond outlet		
1	intermittent		

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## Vermont 2005 Sampling Stations

Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
-72.28008	43.7539	Unnamed trib to Connecticut River	1	1	looked intermittent	0.02
<b>-72.31319</b>	<b>43.71708</b>	<b>Bloody Brook</b>	<b>1</b>	<b>2</b>		0.04
-72.22254	43.81151	Zebedee Brook	1	3		0.02
<b>-72.84834</b>	<b>44.05933</b>	<b>Mad River</b>	<b>2</b>	<b>1</b>		0.01
-72.87003	44.05742	Austin Brook	2	2		0.08
-72.99306	44.24047	Unnamed trib to Huntington River	2	3	looked intermittent	0.03
-72.64987	44.08648	Sunny Brook	3	1		0.02
-72.54358	44.10708	Stevens Branch	3	2		0.01
<b>-72.66161</b>	<b>44.12263</b>	<b>Sunny Brook</b>	<b>3</b>	<b>3</b>		0.04
-72.16561	43.89397	Unnamed trib from Lake Morey to Connecticut River	4	1	too close to pond	0.11
<b>-72.11464</b>	<b>44.10147</b>	<b>Peach Brook</b>	<b>4</b>	<b>2</b>		0.09
-72.14685	44.09613	Unnamed trib to Peach Brook	4	3		0.23
-73.129117	44.475008	Winooski River	5		Regional station	
-73.13606	44.4738	Muddy Brook	5	1		0.02
-73.15041	44.41128	Muddy Brook	5	2		0.12
<b>-73.06863</b>	<b>44.42951</b>	<b>Allen Brook</b>	<b>5</b>	<b>3</b>		0.28
-72.68576	44.4675	Waterbury River	6	1		0.13
-72.91831	44.44361	Unnamed trib to Mill Brook	6	2		0.12
<b>-72.79771</b>	<b>44.50006</b>	<b>Ranch Brook</b>	<b>6</b>	<b>3</b>	site is 0.8 miles from assigned site - accessibility issue	0.02
-72.454332	44.281084	Winooski River	7		Regional station	
<b>-72.49338</b>	<b>44.30918</b>	<b>Sodom Pond Brook</b>	<b>7</b>	<b>1</b>		0.12
-72.47688	44.22505	Gunner Brook	7	2		0.06
-72.37401	44.3304	Winooski River	7	3		0.12
-71.91572	44.50984	Kirby Brook	8	1	too close to Kirby pond	0.11
<b>-71.75918</b>	<b>44.41685</b>	<b>Miles Stream</b>	<b>8</b>	<b>2</b>		0.04
<b>-72.11315</b>	<b>44.37635</b>	<b>Joes Brook</b>	<b>8</b>	<b>3</b>		0.05
-73.04989	44.4769	Winooski River	9	1	looked too deep	0.14
-73.18836	44.52401	Sunderland Brook	9	2		0.11
<b>-73.06607</b>	<b>44.52836</b>	<b>Alder Brook</b>	<b>9</b>	<b>3</b>	0.5 miles from assigned site. No significant land use differences.	0.19

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Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
<b>-72.76371</b>	<b>44.53342</b>	<b>Unnamed trib to West Branch Waterbury River - Pinnacle</b>	<b>10</b>	<b>1</b>	within 0.4 miles of assigned site - accessibility issue.	1.2
-72.68173	44.52137	Sterling Brook	10	2		0.03
-72.66002	44.49387	Sterling Brook	10	3		0.01
-72.071368	44.580823	Miller Run	11	Regiona l station		
<b>-72.10546</b>	<b>44.46837</b>	<b>North Brook</b>	<b>11</b>	<b>1</b>	site was 0.5 miles from assigned site - accessibility issue. No significant land use differences.	0.09
-72.15483	44.56648	Unnamed trib to Miller Run	11	2		0.8
-71.99933	44.57789	Quimby Brook	11	3		0.22
-71.62642	44.50723	Hudson Brook	12	1		0.02
-71.84777	44.50535	Moose River	12	2		0.07
<b>-71.70417</b>	<b>44.61923</b>	<b>Granby Stream</b>	<b>12</b>	<b>3</b>		0.07
-71.83977	44.79282	Unnamed trib to Spectacle Pond	13	1	pond/wetland complex	0.01
<b>-71.80137</b>	<b>44.78402</b>	<b>Unnamed trib to Nulhegan River</b>	<b>13</b>	<b>2</b>	about 0.2 miles upstream of assigned spot - wetland area	0.09
-71.76946	44.77313	Nulhegan River	13	3	wetland	0.25
<b>-71.66302</b>	<b>44.80751</b>	<b>E Branch Nulhegan River</b>	<b>14</b>	<b>1</b>		0.13
-71.58759	44.78456	Lyman Brook	14	2	looked intermittent	0.05
-71.57842	45.00653	Unnamed trib to Leach Creek	14	3	looked intermittent	0.15
<b>-71.64024</b>	<b>45.00529</b>	<b>Morrill Brook</b>	<b>15</b>	<b>1</b>		0.04
-71.63715	45.01016	Unnamed trib to Wallace Pond	15	2	too close to lake outlet	0.03
-71.66246	45.00273	Leach Creek	15	3		0.22

Summary					
2005				average	0.13
45	potential picks			min	0.01
0.22	proportion excluded			max	1.20
1502	stream miles in basin				
334	stream miles excluded				
1168	stream miles assessed				
10	# sites excluded				
1	wetland				
4	lake/pond outlet				
4	intermittent				
1	too deep				

# DRAFT 030508

## Vermont 2006 Sampling Stations

Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
<b>-72.97291</b>	<b>43.31407</b>	<b>McGinn Brook</b>	<b>1</b>	<b>1</b>	0.5 miles downstream from assigned, due to terrain	0.8
-72.9467	43.31156	Unnamed trib to Lake Brook	1	2	wetland	0.7
-72.92447	43.33189	Three Shanties Brook	1	3		0.95
<b>-73.00753</b>	<b>43.39084</b>	<b>Baker Brook</b>	<b>2</b>	<b>1</b>		0.04
-72.927	43.40327	Homer Stone Brook	2	2	too close to pond/wetland complex	0.08
-72.8927	43.39839	Unnamed trib to Fifield Pond	2	3	wetland	0.88
<b>-72.83066</b>	<b>43.44578</b>	<b>Unnamed trib to Mill River</b>	<b>3</b>	<b>1</b>	0.2 miles from assigned, wetland area	0.12
-72.8384	43.49132	Unnamed trib to Freeman Brook	3	2		0.01
-72.86746	43.38822	Meadow Brook	3	3		2.5
<b>-73.10937</b>	<b>43.76537</b>	<b>Bresee Mill Brook</b>	<b>4</b>	<b>1</b>	about 1 mile from assigned site	0.05
-73.3841	43.65589	Horton Brook	4	2		0.4
-73.04286	43.70976	Otter Creek	4	3		0.01
<b>-72.77102</b>	<b>43.75772</b>	<b>Bartlett Brook</b>	<b>5</b>	<b>1</b>		0.48
-72.87271	43.75272	Townsend Brook	5	2	intermittent	1.6
-72.98036	43.5944	Unnamed trib to Otter Creek	5	3		0.05
<b>-72.39967</b>	<b>43.68962</b>	<b>Jericho Brook</b>	<b>6</b>	<b>1</b>		0.02
-72.45259	43.72142	Unnamed trib to Mill Brook	6	2		0.03
-72.64738	43.71529	Locust Creek	6	3		0.04
<b>-73.28961</b>	<b>43.94756</b>	<b>Unnamed trib to Lemon Fair River</b>	<b>7</b>	<b>1</b>		0.4
-73.31452	43.79053	South Fork	7	2	wetland	0.06
-73.30269	43.94169	Unnamed trib to Lemon Fair River	7	3	wetland	0.3
-72.9968	43.86329	Gould Brook	8	1	intermittent	0.25
<b>-72.98378</b>	<b>43.92742</b>	<b>Unnamed trib to Goshen Brook</b>	<b>8</b>	<b>2</b>		0.6
-72.99231	43.84125	Neshobe River	8	3		0.05
-72.711458	43.945966	Third Branch White River	9	Region Station	NEWS 2001	
-72.65893	43.74494	Unnamed trib to Locust Creek	9	1	intermittent	0.04
<b>-72.57091</b>	<b>43.82851</b>	<b>Second Branch White River</b>	<b>9</b>	<b>2</b>		0.07
-72.80717	43.9264	Howe Brook	9	3	too close to pond	0.05

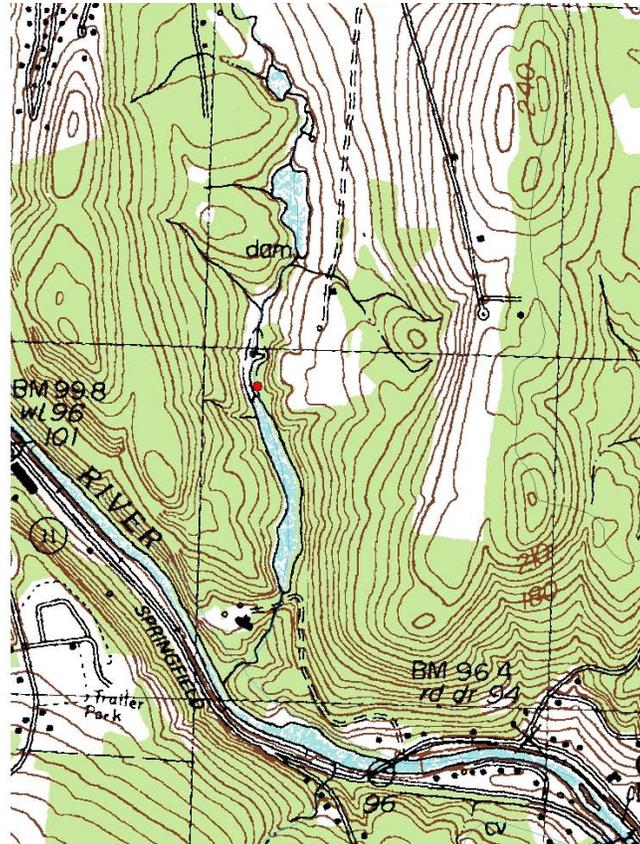
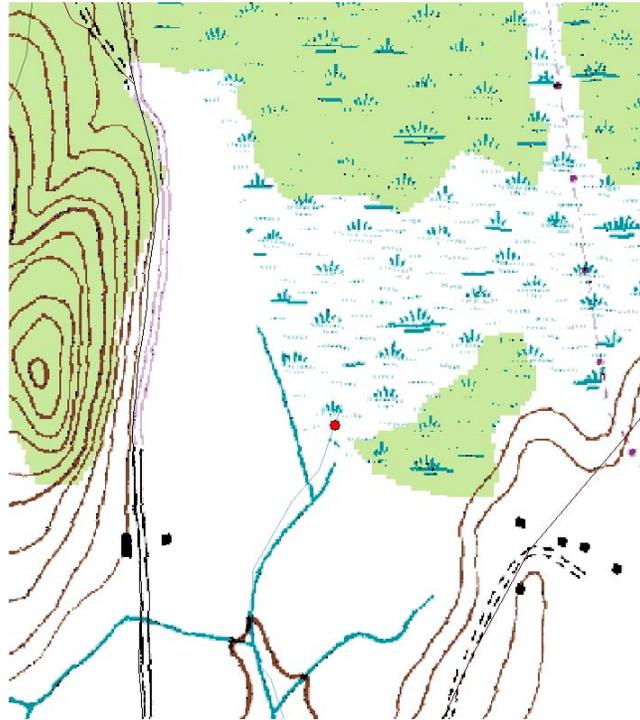
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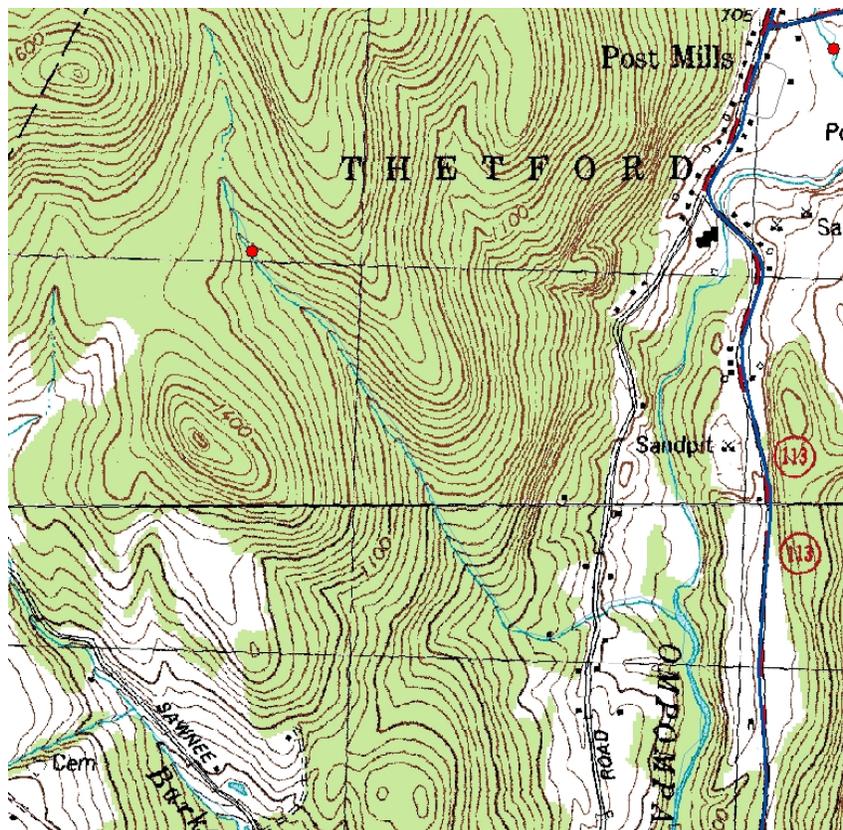
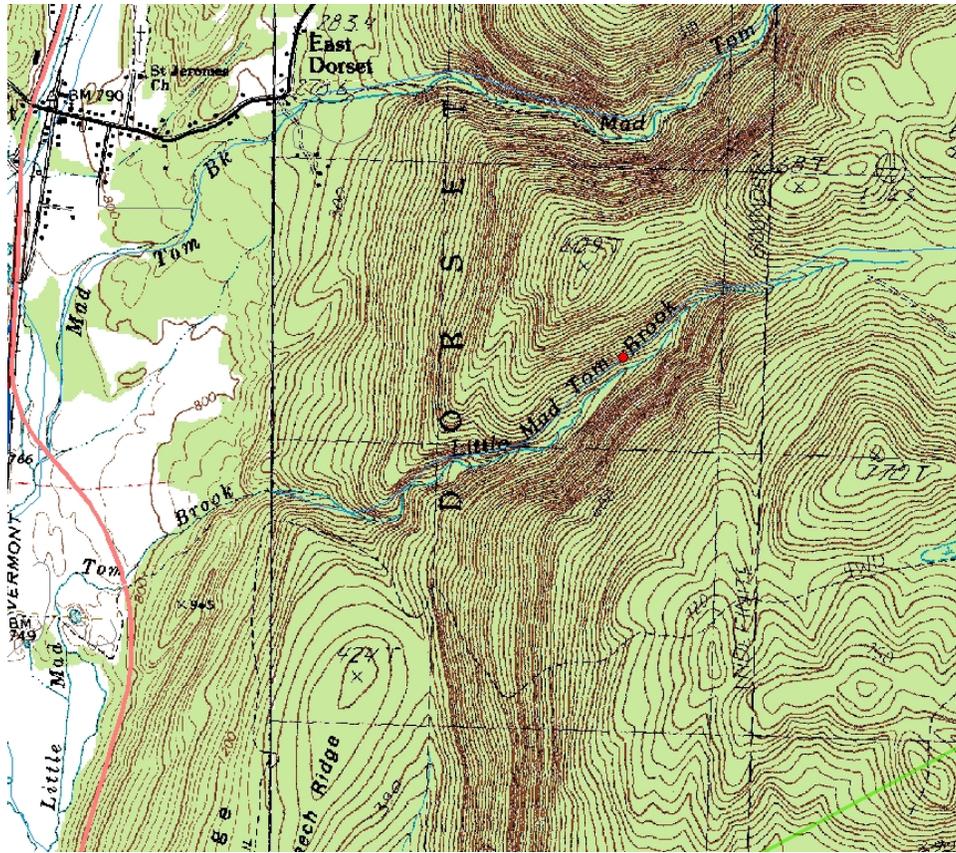
Longitude (D.D°)	Latitude (D.D°)	Stream Name	Rot Hex	Pick #	Comments	Distance from nearest road (miles)
<b>-72.41704</b>	<b>43.96111</b>	<b>Jenkins Brook</b>	<b>10</b>	<b>1</b>		0.01
-72.47807	43.91396	First Branch White River	10	2		0.03
-72.44134	43.9498	Bicknell Brook	10	3	0.2 miles from pond	0.1
-73.29802	44.1926	Unnamed trib to Lower Otter Creek WMA	11	1		0.8
<b>-73.19074</b>	<b>44.19297</b>	<b>Little Otter Creek</b>	<b>11</b>	<b>2</b>	1 mile off, access and wetland issue	0.07
-73.34954	44.07488	West Branch Dead Creek	11	3	wetland	0.04
<b>-72.96826</b>	<b>44.06173</b>	<b>New Haven River</b>	<b>12</b>	<b>1</b>		0.05
-72.75102	43.99542	Third Branch White River	12	2		0.07
-72.88535	43.9936	White River	12	3		0.05
-72.55597	43.97817	Second Branch White River	13	1	too deep	0.03
-72.53952	44.01775	Halfway Brook	13	2		0.16
<b>-72.46062</b>	<b>43.96717</b>	<b>First Branch White River</b>	<b>13</b>	<b>3</b>		0.01
-73.2788	44.33287	Holmes Creek	14	1	too close to pond	0.15
<b>-73.22349</b>	<b>44.25146</b>	<b>Lewis Creek</b>	<b>14</b>	<b>2</b>		0.2
-73.20973	44.26051	Lewis Creek	14	3		0.1
<b>-73.10654</b>	<b>44.28145</b>	<b>Lewis Creek</b>	<b>15</b>	<b>1</b>		0.13
-73.03134	44.24842	Unnamed trib to Lewis Creek	15	2		0.06
-73.06078	44.23176	Lewis Creek	15	3		0.2

Summary						
2006					average	0.29
45	potential picks				min	0.01
0.29	proportion excluded				max	2.50
1585	stream miles in basin					
458	stream miles excluded					
1127	stream miles assessed					
13	# sites excluded					
5	wetland					
4	lake/pond outlet					
3	intermittent					
1	too deep					

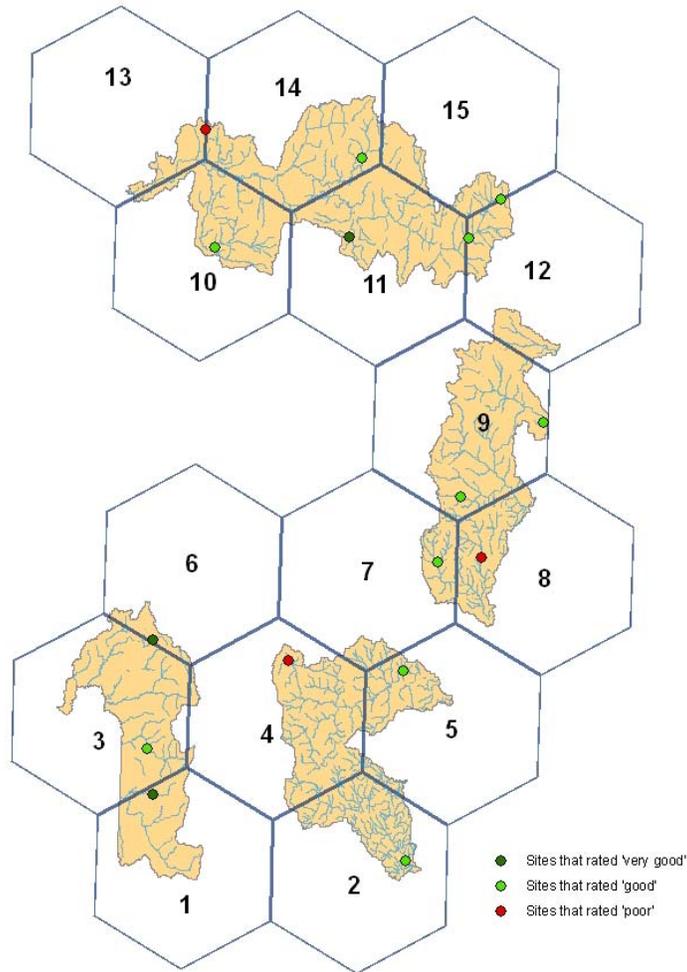
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Appendix 2, Figure 1. Examples of sites that were excluded or moved.



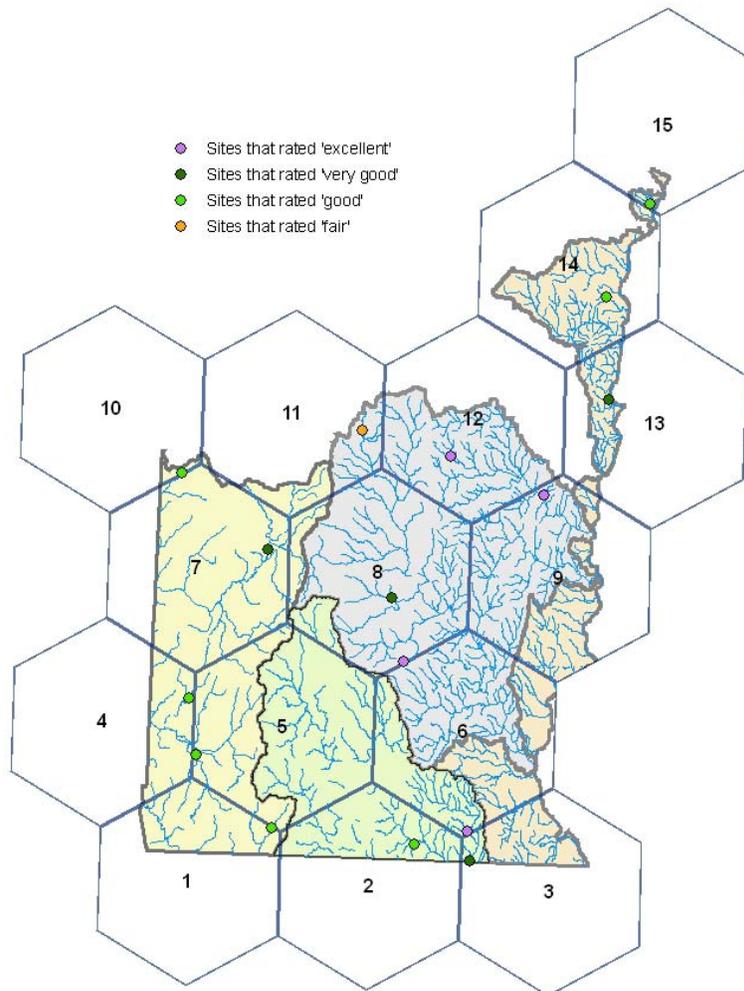


2002 Data



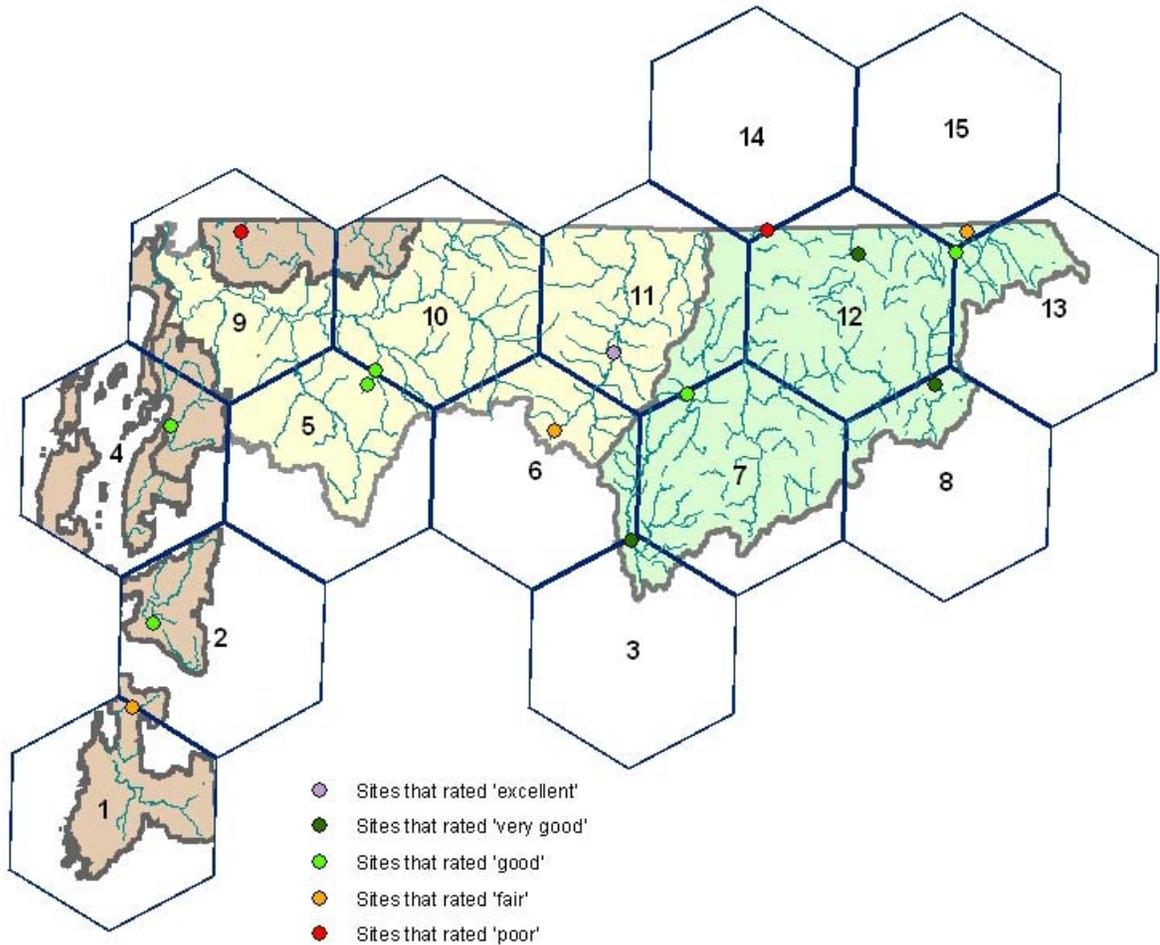
Hex ID	Stream miles in Hex	Basin	Site name (RM)	Overall Rating	Macro Rating	Fish Rating
1	49.3	Poult-Mett	Wells Brook (5.5)	Very Good	Vgood	Vgood
2	190.8	Otta-Black	Seavers Brook (0.1)	Good	G-Fair	Exc
3	142.2	Poult-Mett	Poultney River (30.9)	Good	Good	Good
4	190.4	Otta-Black	Kent Pond Outlet (0.4)	Poor	F-Poor	Poor
5	101.9	Otta-Black	Whitman Bk. Trib #1 (1.3)	Good	Vgood	Good
6	8.3	Poult-Mett	Giddings Brook (2.4)	Very Good	Vgood	NA
7	71.0	SWWO	Old City Brook (0.2)	Good	Good	Exc
8	117.3	SWWO	Ompompanoosuc R. (13.6)	Poor	Fair	Poor
9	90.2	SWWO	Meadow Brook (4.4)	Good	Good	Vgood
9	90.2	SWWO	Wells River Trib 3# (0.8)	Good	Good	NA
10	120.6	Lamoille	Browns R. (20.4)	Good	Good	Vgood
11	154.4	Lamoille	Ryder Bk (trib 5) (0.8)	Very Good	Vgood	Exc
12	58.8	Lamoille	Lamoille River (76.8)	Good	Vgood	Good
13	19.8	Lamoille	Mill Brook (Fairfax) (10.8)	Poor	Good	Poor
14	161.4	Lamoille	Gihon River (10.3)	Good	Exc	Good
15	47.1	Lamoille	Morrison Bk. (0.9)	Good	Exc	Good

2003 Data



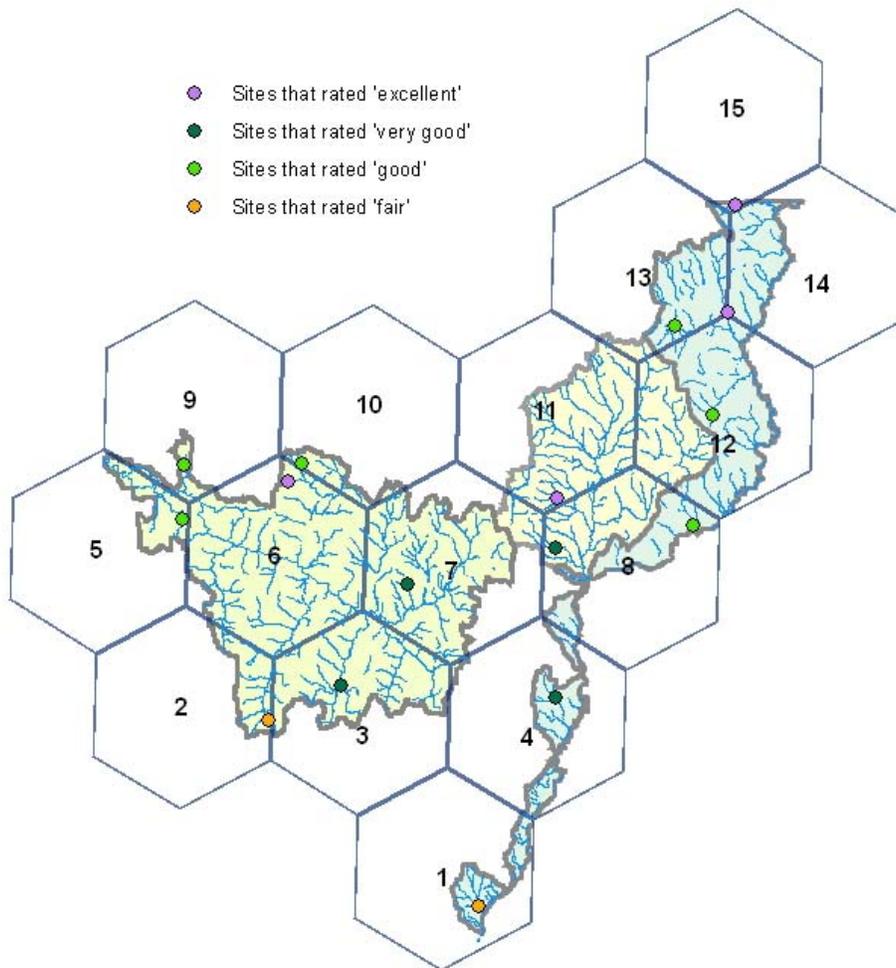
Hex ID	Stream miles in Hex	Basin	Site name (RM)	Overall Rating	Macro Rating	Fish Rating
1	42.6	Batt-Wall-Hoos	N. Br. Hoosic River (8.1)	Good	Good	Good
2	69.6	Deerfield	East Branch North River (14.4)	Good	Good	Good
3	62.9	Deerfield	Green River (13.8)	Very Good	Exc	Vgood
4	33.4	Batt-Wall-Hoos	Paran Creek (3.1)	Good	Vgood	Good
5	162.1	Batt-Wall-Hoos	South Stream (0.1)	Good	Good	Vgood
6	298.2	Deerfield	Green River Trib #4 (1.7)	Excellent	Ex-Vgood	Exc
7	111.4	Batt-Wall-Hoos	Batten Kill (48.0)	Very Good	Vg-Good	NA
8	108.7	West-Will-Sax	N. Branch Ball Mtn Brook (0.4)	Very Good	Exc	Vgood
8	108.7	West-Will-Sax	Wardsboro Bk. Trib #5 (3.9)	Excellent	Exc	NA
9	239.2	West-Will-Sax	Williams River Trib #11 (0.4)	Excellent	Exc	Exc
10	1.3	Batt-Wall-Hoos	Mill Brook - Rupert (2.8)	Good	Good	Exc
11	40.3	West-Will-Sax	Mt. Tabor Brook (1.9)	Fair	Exc	Fair
12	154.7	West-Will-Sax	Andover Branch (4.8)	Excellent	Exc	Exc
13	65.4	Low Connecticut	Blood Brook (0.1)	Very Good	Vg-Good	Exc
14	134.9	Low Connecticut	Hubbard Brook (4.0)	Good	Good	Exc
15	8.2	Low Connecticut	Kilburn Brook (0.6)	Good	G-Fair	Exc

2004 Data



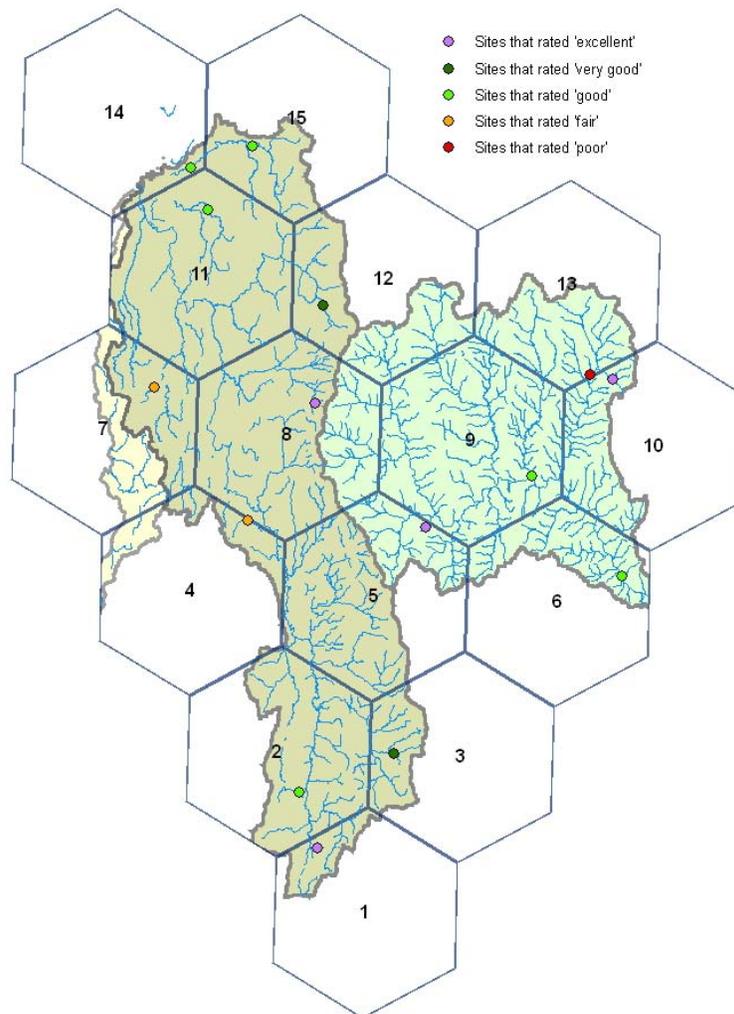
Hex ID	Stream miles in Hex	Basin	Site Name (RM)	Overall Rating	Macro Rating	Fish Rating
1	31.3	N Lk Champlain	Potash Brook (2.1)	Fair	Fair	NA
2	34.1	N Lk Champlain	Indian Brook (3.1)	Good	G-Fair	Good
3	11.2	Lk Memph	Black River - Craftsbury (30.5)	Very Good	Vg-Good	NA
4	29.0	N Lk Champlain	Mill River - Georgia (0.7)	Good	Good	NA
5	54.8	Missisquoi	Beaver Meadow Brook (2.0)	Good	Exc	Good
6	56.1	Missisquoi	Burgess Branch (4.8)	Fair	Fair	NA
7	124.2	Lk Memph	Brighton Brook (0.9)	Good	Good	Good
8	27.0	Lk Memph	Pherrins River (1.9)	Very Good	Exc	Vgood
9	104.6	N Lk Champlain	Rock River (5.9)	Poor	Poor	Fair
10	149.5	Missisquoi	The Branch (1.0)	Good	Good	Good
11	133.5	Missisquoi	Mineral Spring Brook (0.2)	Excellent	Ex-Vgood	NA
12	137.3	Lk Memph	Stearns Brook (2.3)	Very Good	Vg-Good	NA
13	35.7	Lk Memph	Sutton Brook (0.4)	Good	Exc	Good
14	2.0	Lk Memph	Johns River (1.4)	Poor	Fair	Poor
15	3.9	Lk Memph	Mosher Meadow Brook (0.2)	Fair	Exc	Fair

2005 Data



Hex ID	Stream miles in Hex	Basin	Site Name (RM)	Overall Rating	Macro Rating	Fish Rating
1	57.4	Upper Connecticut	Bloody Brook (1.6)	Fair	Vgood	Fair
2	43.8	Winooski	Mad River (23.6)	Fair	Ex-Vgood	Fair
3	137.5	Winooski	Sunny Brook (0.3)	Very Good	Vgood	Vgood
4	56.1	Upper Connecticut	Peach Brook (4.2)	Very Good	Ex-Vgood	Vgood
5	35.5	Winooski	Allen Brook (8.2)	Good	Good	NA
6	264.6	Winooski	Ranch Brook (1.5)	Excellent	Exc	NA
7	216.3	Winooski	Sodom Pond Brook (3.9)	Very Good	Vg-Good	NA
8	65.9	Passumpsic	Joe's Brook (6.3)	Very Good	Vgood	Vgood
8	65.9	Upper Connecticut	Miles Stream (0.6)	Good	Exc	Good
9	15.7	Winooski	Alder Brook (4.1)	Good	Good	NA
10	21.6	Winooski	Pinnacle (1.3)	Good	Good	NA
11	178.0	Passumpsic	North Brook (0.4)	Excellent	NA	Exc
12	196.8	Upper Connecticut	Granby Stream (2.9)	Good	Good	NA
13	80.3	Upper Connecticut	Nulhegan River (15.1)	Good	Ex-Vgood	Good
14	63.2	Upper Connecticut	E Branch Nulhegan River (2.9)	Excellent	Exc	NA
15	2.8	Upper Connecticut	Morrill Brook (0.1)	Excellent	Ex-Vgood	Exc

2006 Data



Hex ID	Stream miles in Hex	Basin	Site Name (RM)	Overall Rating	Macro Rating	Fish Rating
1	22.3	Otter	McGinn Brook (0.7)	Excellent	Ex-Vgood	Exc
2	119.2	Otter	Baker Brook (1.2)	Good	Exc	Good
3	40.7	Otter	Mill Brook Trib (3.1)	Very Good	Vg-Good	NA
4	30.3	Otter	Bresee Mill Brook (4.3)	Fair	Exc	Fair
5	212.5	White	Bartlett Brook (1.2)	Excellent	Exc	Exc
6	102.8	White	Jericho Brook (0.1)	Good	G-Fair	Exc
7	86.6	Otter	Lemon Fair River Trib #9 (2.3)	Fair	Fair	NA
8	190.9	Otter	Goshen Bk. Trib #2 (0.2)	Excellent	Exc	Exc
9	304.5	White	Second Branch White River (0.3)	Good	Good	Good
10	94.7	White	Jenkins (2.6)	Excellent	Exc	NA
11	151.5	Otter	Little Otter Creek (7.0)	Good	Vg-Good	Good
12	87.1	Otter	New Haven River (20.9)	Very Good	Ex-Vgood	Vgood
13	89.9	White	First Branch White River (15.7)	Poor	Good	Poor
14	13.8	Otter	Lewis Creek (4.1)	Good	Good	Vgood
15	38.1	Otter	Lewis Creek (13.9)	Good	Vg-Good	Good



# DRAFT 030508

## Site Information

Longitude (D.D°)	Latitude (D.D°)	VTSiteID	Site Name (RM)	Drainage Area (km2)	Elevation (ft)
-72.80041	43.00695	032605000039	Wardsboro Bk. Trib #5 (3.9)	1.12	1735
-72.98378	43.92742	55150508B002	Goshen Bk. Trib #2 (0.2)	2.6	1695
-72.97291	43.31407	557200000007	McGinn Brook (0.7)	2.8	850
-72.71451	43.28638	071605000048	Andover Branch (4.8)	3	1230
-72.76371	44.53342	493238240013	Pinnacle (1.3)	4.2	1500
-72.81890	44.82409	423804040020	Beaver Meadow Brook (2.0)	4.5	626
-72.77102	43.75772	134601000012	Bartlett Brook (1.2)	4.6	1044
-72.34021	43.63150	VTT132600006	Kilburn Brook (0.6)	4.6	376
-72.87958	43.32177	034010000019	Mt. Tabor Brook (1.9)	5.9	1685
-71.86221	44.97664	321700000004	Sutton Brook (0.4)	5.9	1338
-73.02729	44.74015	461200000108	Mill Brook (Fairfax) (10.8)	6.3	585
-72.41816	43.36452	VTT136000001	Blood Brook (0.1)	6.8	355
-71.84596	44.99939	321100000002	Mosher Meadow Brook (0.2)	7	1315
-72.39967	43.68962	130800000001	Jericho Brook (0.1)	7.1	413
-72.42270	43.50408	VTT132000040	Hubbard Brook (4.0)	7.53	630
-73.10937	43.76537	552600000043	Bresee Mill Brook (4.3)	9.3	670
-73.21576	43.26250	590107000028	Mill Brook - Rupert (2.8)	9.7	926
-72.68071	42.77379	670400000017	Green River Trib #4 (1.7)	9.76	890
-72.79771	44.50006	493238200015	Ranch Brook (1.5)	9.9	1240
-73.06863	44.42951	490501000082	Allen Brook (8.2)	10.1	518
-72.41704	43.96111	132514000026	Jenkins (2.6)	10.3	1260
-72.47342	43.65986	121201000013	Whitman Bk. Trib #1 (1.3)	11.5	955
-72.49338	44.30918	496100000039	Sodom Pond Brook (3.9)	12.3	1010
-71.70417	44.61923	260300000029	Granby Stream (2.9)	12.6	1450
-71.64024	45.00529	310500000001	Morrill Brook (0.1)	12.6	1315
-72.84834	44.05933	494000000236	Mad River (23.6)	12.7	1244
-73.00753	43.39084	556300000012	Baker Brook (1.2)	12.9	860
-72.83066	43.44578	554615000031	Mill Brook Trib (3.1)	13.4	1380
-72.08728	44.15508	190300000008	Wells River Trib 3# (0.8)	13.8	613
-72.79117	43.67838	126600000004	Kent Pond Outlet (0.4)	14.8	1400
-72.02246	44.97534	350200000023	Stearns Brook (2.3)	16.1	1213
-72.46767	43.27926	805000000001	Seavers Brook (0.1)	16.5	334
-73.19456	44.44752	500000000021	Potash Brook (2.1)	17.1	210
-73.06607	44.52836	490700000041	Alder Brook (4.1)	17.3	151
-72.11464	44.10147	180300000042	Peach Brook (4.2)	19.1	670
-72.30070	44.81305	391200000009	Brighton Brook (0.9)	22	842
-72.96826	44.06173	551200000209	New Haven River (20.9)	27.3	1330
-73.16345	44.54559	480000000031	Indian Brook (3.1)	28	164
-71.80137	44.78402	280000000151	Nulhegan River (15.1)	30	1155
-72.41907	44.86226	428600000002	Mineral Spring Brook (0.2)	30.2	790
-72.82415	43.09353	328040000004	N. Branch Ball Mtn Brook (0.4)	34.25	1108
-72.80592	44.84082	423804000010	The Branch (1.0)	38.2	489
-72.31319	43.71708	140000000016	Bloody Brook (1.6)	40.6	517
-71.89924	44.82300	373100000019	Pherrins River (1.9)	52	1246
-71.75918	44.41685	220000000006	Miles Stream (0.6)	53.9	830
-73.13751	44.77531	440000000007	Mill River - Georgia (0.7)	66	115
-72.78023	42.75703	280200000029	E Branch Nulhegan River (2.9)	83	1067
-72.39174	44.64351	390000000305	Black River - Craftsbury (30.5)	84	880

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## Site Information continued...

Longitude (D.D°)	Latitude (D.D°)	VTSiteID	Site Name (RM)	Drainage Area (km2)	Elevation (ft)
-72.58880	44.68535	463200000103	Gihon River (10.3)	94	890
-73.10654	44.28145	530000000139	Lewis Creek (13.9)	98	345
-73.19074	44.19297	540000000070	Little Otter Creek (7.0)	98.1	175
-72.46062	43.96717	132500000140	First Branch White River (15.7)	127	723
-73.05449	43.15774	590000000480	Batten Kill (48.0)	156	665
-72.29265	44.52382	460000000768	Lamoille River (76.8)	192	1081
-72.99923	44.50486	461100000204	Browns R. (20.4)	102.6	525
-72.51448	44.77098	429500000048	Burgess Branch (4.8)	5.7	1100
-71.66302	44.80751	660600000144	East Branch North River (14.4)	54.4	1040
-73.16195	43.71948	571104150024	Giddings Brook (2.4)	9.9	800
-72.67601	42.73383	670000000138	Green River (13.8)	90	580
-72.11315	44.37635	210300000063	Joe's Brook (6.3)	104	1100
-72.16903	45.00372	360000000014	Johns River (1.4)	22.5	700
-73.28961	43.94756	551009000023	Lemon Fair River Trib #9 (2.3)	24.7	150
-73.22349	44.25146	530000000041	Lewis Creek (4.1)	199.6	150
-72.31698	44.00671	171005000044	Meadow Brook (4.4)	15.4	1100
-72.20180	44.60266	468300000009	Morrison Bk. (0.9)	5.2	1380
-73.04531	42.77824	610000000081	N. Br. Hoosic River (8.1)	22.2	1250
-72.10546	44.46837	211109000004	North Brook (0.4)	14.5	1000
-72.37907	43.87688	150414000002	Old City Brook (0.2)	19.7	1000
-72.25854	43.88554	150000000136	Ompompanoosuc R. (13.6)	83	700
-73.20047	42.95424	600500000031	Paran Creek (3.1)	16.5	750
-73.17423	43.50048	570000000309	Poultney River (30.9)	72.2	650
-73.02483	45.00010	411300000059	Rock River (5.9)	59.5	200
-72.62519	44.52761	464305000008	Ryder Bk (trib 5) (0.8)	4.7	750
-72.57091	43.82851	132900000003	Second Branch White River (0.3)	192.5	500
-73.18609	42.87653	601100000001	South Stream (Jewett Brook) (0.1)	70.6	750
-72.66161	44.12263	495127000003	Sunny Brook (0.3)	44.1	800
-73.15912	43.40927	580300000055	Wells Brook (5.5)	25.9	800
-72.53991	43.23453	071100000004	Williams River Trib #11 (0.4)	8.3	580

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## Summary of biological information

Site name (River Mile)	MACROINVERTEBRATE						FISH				
	Date	LabID	Assess	Basis	Type	Collection method	Date	Event ID	Assess	Basis	IBI type
Alder Brook (4.1)	10/13/2005	2005.130	Good	BPJ	SW	SW	10/13/2005	2005-40	NA		
Allen Brook (8.2)	10/4/2005	2005.116	Good	BIO	WWMG	VT Kick	NS		NA		
Andover Branch (4.8)	9/2/2003	2003.031	Exc	BIO	SHG	VT Kick	9/2/2003	2003-34	Exc	BIO	CW
Baker Brook (1.2)	9/21/2006	2006.072	Exc	BIO	SHG	VT Kick	9/21/2006	2006-24	Good	BPJ	CW
Bartlett Brook (1.2)	9/22/2006	2006.081	Exc	BIO	SHG	VT Kick	9/22/2006	2006-25	Exc	BIO	CW
Batten Kill (48.0)	9/3/2003	2003.029	Vg-Good	BIO	MHG	VT Kick	9/3/2003	2003-36	NA		
Beaver Meadow Brook (2.0)	9/1/2004	2004.039	Exc	BIO	SHG	VT Kick	10/15/2004	2004-45	Good	BIO	MW
Black River - Craftsbury (30.5)	10/13/2004	2004.174	Vg-Good	BPJ	SW	SW	NS		NA		
Blood Brook (0.1)	9/23/2003	2003.092	Vg-Good	BIO	SHG	VT Kick	7/3/2003	2003-13	Exc	BIO	CW
Bloody Brook (1.6)	9/13/2006	2006.053	Vgood	BIO	MHG	VT Kick	9/13/2006	2006-11	Fair	BIO	CW
Bresee Mill Brook (4.3)	10/6/2006	2006.123	Exc	BIO	SHG	VT Kick	10/6/2006	2006-42	Fair	BIO	CW
Brighton Brook (0.9)	9/21/2004	2004.094	Good	BPJ	SW	SW	9/21/2004	2004-23	Good	BPJ	
Browns R. (20.4)	7/16/2002	NA	Good	BPJ	MHG	NEWS	7/16/2002	2002-05	Vgood	BIO	MW
Burgess Branch (4.8)	8/7/2002	NA	Fair	BPJ	SHG	NEWS	8/7/2002	2002-22	NA		
E Branch Nulhegan River (2.9)	9/9/2005	2005.050	Exc	BIO	MHG	VT Kick	NS		NA		
East Branch North River (14.4)	7/14/2003	NA	Good	BPJ	MHG	NEWS	7/15/2003	2003-22	Good	BIO	MW
First Branch White River (15.7)	9/13/2006	2006.052	Good	BIO	MHG	VT Kick	9/13/2006	2006-10	Poor	BIO	MW
Giddings Brook (2.4)	7/31/2002	NA	VGood	BPJ	SHG	NEWS	7/31/2002	2002-15	NA		
Gihon River (10.3)	9/10/2002	2002.052	Exc	BIO	MHG	VT Kick	7/24/2002	2002-09	Good	BIO	MW
Goshen Bk. Trib #2 (0.2)	9/24/2003	2003.086	Exc	BIO	SHG	VT Kick	7/9/2003	2003-15	Exc	BIO	CW
Granby Stream (2.9)	8/20/2003	2003.018	Good	BPJ	SW	SW	NS		NA		
Green River (13.8)	7/14/2003	NA	Exc	BPJ	MHG	NEWS	7/14/2003	2003-20	VGood	BIO	MW
Green River Trib #4 (1.7)	9/11/2003	2003.056	Ex-Vgood	BIO	SHG	VT Kick	7/14/2003	2003-21	Exc	BIO	CW
Hubbard Brook (4.0)	9/24/2003	2003.091	Good	BIO	SHG	VT Kick	7/8/2003	2003-14	Exc	BIO	CW
Indian Brook (3.1)	10/1/2004	2004.138	G-Fair	BIO	WWMG	VT Kick	10/7/2004	2004-34	Good	BIO	MW
Jenkins (2.6)	9/18/2006	2006.060	Exc	BIO	SHG	VT Kick	9/18/2006	2006-16	NA		
Jericho Brook (0.1)	9/12/2006	2006.043	G-Fair	BIO	SHG	VT Kick	9/12/2006	2006-09	Exc	BIO	CW
Joe's Brook (6.3)	8/19/2003	NA	Vgood	BPJ	MHG	NEWS	8/19/2003	2003-28	VGood	BIO	MW

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	MACROINVERTEBRATE						FISH				
Site name (River Mile)	Date	LabID	Assess	Basis	Type	Collection method	Date	Event ID	Assess	Basis	IBI type
Johns River (1.4)	8/19/2003	NA	Fair	BPJ	SW	NEWS	8/20/2003	2003-30	Poor	BIO	MW
Kent Pond Outlet (0.4)	9/11/2002	2002.055	F-Poor	BIO	SHG	VT Kick	7/30/2002	2002-13	Poor	BIO	CW
Kilburn Brook (0.6)	9/18/2003	2003.080	G-Fair	BIO	SHG	VT Kick	8/7/2003	2003-27	Exc	BIO	CW
Lamoille River (76.8)	9/3/2002	2002.031	Vgood	BIO	MHG	VT Kick	7/17/2002	2002-06	Good	BIO	MW
Lemon Fair River Trib #9 (2.3)	6/17/2003	NA	Fair	BPJ	SW	NEWS	6/7/2003	2003-04	NA		
Lewis Creek (13.9)	9/27/2006	2006.085	Vg-Good	BIO	WWMG	VT Kick	9/27/2006	2006-30	Good	BIO	MW
Lewis Creek (4.1)	7/18/2002	NA	Good	BPJ	WWMG	NEWS	7/18/2002	2002-07	Vgood	BIO	MW
Little Otter Creek (7.0)	9/18/2006	2006.064	Vg-Good	BIO	WWMG	VT Kick	9/18/2006	2006-18	Good	BIO	MW
Mad River (23.6)	9/15/2005	2005.062	Ex-Vgood	BIO	SHG	VT Kick	9/15/2005	2005-18	Fair	BIO	CW
McGinn Brook (0.7)	9/21/2006	2006.071	Ex-Vgood	BIO	SHG	VT Kick	9/21/2006	2006-23	Exc	BIO	CW
Meadow Brook (4.4)	7/26/2002	NA	Good	BPJ	SHG	NEWS	7/26/2002	2002-12	Vgood	BIO	CW
Miles Stream (0.6)	9/23/2003	2003.087	Exc	BIO	MHG	VT Kick	8/6/2003	2003-26	Good	BIO	MW
Mill Brook - Rupert (2.8)	9/3/2003	2003.033	Good	BIO	SHG	VT Kick	7/9/2003	2003-16	Exc	BIO	MW
Mill Brook (Fairfax) (10.8)	10/1/2002	2002.100	Good	BIO	WWMG	VT Kick	8/5/2002	2002-19	Poor	BIO	MW
Mill Brook Trib (3.1)	9/21/2006	2006.080	Vg-Good	BIO	SHG	VT Kick	NS		NA		
Mill River - Georgia (0.7)	10/5/2004	2004.141	Good	BIO	WWMG	VT Kick	NS		NA		
Mineral Spring Brook (0.2)	9/24/2004	2004.114	Ex-Vgood	BIO	MHG	VT Kick	9/24/2004	2004-26	NA		
Morrill Brook (0.1)	9/23/2003	2003.090	Ex-Vgood	BIO	SHG	VT Kick	8/22/2003	2003-32	Exc	BIO	MW
Morrison Bk. (0.9)	7/23/2002	NA	Exc	BPJ	SHG	NEWS	7/23/2002	2002-08	Good	BIO	CW
Mosher Meadow Brook (0.2)	9/23/2003	2003.089	Exc	BIO	SHG	VT Kick	8/21/2003	2003-31	Fair	BIO	MW
Mt. Tabor Brook (1.9)	9/4/2003	2003.032	Exc	BIO	SHG	VT Kick	7/1/2003	2003-11	Fair	BIO	CW
N. Br. Hoosic River (8.1)	7/10/2003	NA	Good	BPJ	SHG	NEWS	7/10/2003	2003-19	Good	BIO	CW
N. Branch Ball Mtn Brook (0.4)	9/2/2003	2003.030	Exc	BIO	MHG	VT Kick	9/2/2003	2003-33	VGood	BIO	MW
New Haven River (20.9)	9/8/2006	2006.034	Ex-Vgood	BIO	MHG	VT Kick	9/18/2006	2006-17	Vgood	BIO	CW
North Brook (0.4)					MHG		9/12/2005	2005-11	Exc	BIO	CW
Nulhegan River (15.1)	9/8/2006	2006.033	Ex-Vgood	BPJ	SW	VT Kick	9/7/2006	2006-06	Good	BPJ	
Old City Brook (0.2)	8/1/2002	NA	Good	BPJ	SHG	NEWS	8/1/2022	2002-17	Exc	BIO	CW
Ompompanoosuc R. (13.6)	7/11/2002	NA	Fair	BPJ	MHG	NEWS	7/11/2002	2002-03	Poor	BIO	MW

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Site name (River Mile)	MACROINVERTEBRATE						FISH				
	Date	LabID	Assess	Basis	Type	Collection method	Date	Event ID	Assess	Basis	IBI type
Paran Creek (3.1)	6/30/2003	NA	Vgood	BPJ	SW	NEWS	6/30/2003	2003-10	Good	BIO	MW
Peach Brook (4.2)	9/9/2003	2003.041	Ex-Vgood	BPJ	SW	SW	6/24/2003	2003-06	Vgood	BIO	MW
Pherrins River (1.9)	9/23/2003	2003.088	Exc	BIO	MHG	VT Kick	8/20/2003	2003-29	Vgood	BIO	MW
Pinnacle (1.3)	9/28/2005	2005.103	Good	BIO	SHG	VT Kick	NS		NA		
Potash Brook (2.1)	9/21/2004	2004.092	Fair	BPJ	SW	SW	9/13/2004	2004-22	NA		
Poultney River (30.9)	6/28/2002	NA	Good	BPJ	MHG	NEWS	7/10/2002	2002-02	Good	BIO	MW
Ranch Brook (1.5)	9/14/2005	2005.060	Exc	BIO	SHG	VT Kick	9/14/2005	2005-17	NA		
Rock River (5.9)	8/5/2002	NA	Poor	BPJ	WWMG	NEWS	8/5/2002	2002-18	Fair	BIO	MW
Ryder Bk (trib 5) (0.8)	6/25/2002	NA	VGood	BPJ	SHG	NEWS	7/12/2002	2002-04	Exc	BIO	MW
Seavers Brook (0.1)	9/12/2002	2002.059	G-Fair	BIO	SHG	VT Kick	7/30/2002	2002-14	Exc	BIO	MW
Second Branch White River (0.3)	7/2/2002	NA	Good	BPJ	MHG	NEWS	7/25/2002	2002-10	Good	BIO	MW
Sodom Pond Brook (3.9)	9/6/2005	2005.029	Vg-Good	BIO	SHG	VT Kick	9/6/2005	2005-14	NA		
South Stream (0.1)	7/15/2003	NA	Good	BPJ	MHG	NEWS	7/15/2003	2003-23	Vgood	BIO	MW
Stearns Brook (2.3)	9/16/2004	2004.088	Vg-Good	BIO	SHG	VT Kick	9/16/2004	2004-20	NA		
Sunny Brook (0.3)	6/25/2003	NA	Vgood	BPJ	MHG	NEWS	6/25/2003	2003-07	Vgood	BIO	MW
Sutton Brook (0.4)	9/17/2004	2004.089	Exc	BIO	SHG	VT Kick	9/16/2004	2004-18	Good	BIO	MW
The Branch (1.0)	10/15/2004	2004.176	Good	BIO	MHG	VT Kick	10/15/2004	2004-46	Good	BIO	MW
Wardsboro Bk. Trib #5 (3.9)	10/1/2003	2003.105	Exc	BIO	SHG	VT Kick	6/30/2003	2003-09	NA		
Wells Brook (5.5)	7/2/2002	NA	Vgood	BPJ	MHG	NEWS	7/31/2002	2002-16	Vgood	BIO	CW
Wells River Trib 3# (0.8)	9/9/2003	2003.043	Good	BPJ	SW	SW	6/26/2003	2003-08	NA		
Whitman Bk. Trib #1 (1.3)	9/9/2002	2002.046	Vgood	BIO	SHG	VT Kick	7/25/2002	2002-11	Good	BIO	CW
Williams River Trib #11 (0.4)	7/1/2003	NA	Exc	BPJ	SHG	NEWS	7/1/2003	2003-12	Exc	BIO	CW

Assessment basis: BIO = VTDEC Biocriteria or IBI applied; BPJ = Best Professional Judgment with reference to BCG applied

BCG = Biological Condition Gradient

Macroinvertebrate stream types: SHG = Small high gradient; MHG = Medium high gradient; WWMG = Warm water medium gradient; SW = Slow winder

Fish Index of Biotic Integrity (IBI) type: MW = Mixed water; CW = cold water

Collection method: VT Kick = VTDEC riffle kick net; NEWS = USEPA multihabitat; SW = VTDEC low gradient sweep

NS = Not sampled; NA = Not assessed

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