

New Hampshire Volunteer River Assessment Program 2008 Exeter River Watershed Water Quality Report



February 2009

**New Hampshire Volunteer River Assessment Program
2008 Exeter River Watershed Water Quality Report**

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Cover Photo: Little River, 02-LTE, Exeter

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1.0 INTRODUCTION

1.1. Purpose of Report

Each year the New Hampshire Volunteer River Assessment Program prepares and distributes a water quality report for each volunteer river monitoring group that is based solely on the water quality data collected by that group during a specific year. The reports summarize and interpret the data, particularly as they relate to New Hampshire's surface water quality standards, and serve as a teaching tool and guidance document for future monitoring activities by the individual volunteer groups.

1.2. Report Format

Each report includes the following:

■ Volunteer River Assessment Program Overview

This section includes a description of the history of VRAP, the technical support, training and guidance provided by NHDES, and how data is transmitted to the volunteers and used in surface water quality assessments.

■ Monitoring Program Description

This section provides a description of the volunteer group's monitoring program including monitoring objectives as well as a table and map showing sample station locations.

■ Results and Recommendations

Water quality data collected during the year are summarized on a parameter-by-parameter basis using: (1) a data summary table, which includes the number of samples collected, data ranges, the number of samples meeting New Hampshire water quality standards, and the number of samples adequate for water quality assessments at each station; (2) a discussion of the data; (3) a river graph showing the range of measured values at each station; and (4) a list of applicable recommendations.

Sample results reported as less than the detection limit were assumed equal to one-half the detection limit on the river graphs. This approach simplifies the understanding of the parameter of interest, and specifically helps one to visualize how the river or watershed is functioning from upstream to downstream. In addition, this format allows the reader to better understand potential pollution areas and target those areas for additional sampling or environmental enhancements. Where applicable, the river graph also shows New Hampshire surface water quality standards or levels of concern for comparison purposes.

■ **Appendix A – Water Quality Data**

This appendix includes a spreadsheet detailing the data results and additional information such as data results which do not meet New Hampshire surface water quality standards, and data that are unusable for assessment purposes due to quality control requirements.

■ **Appendix B – Interpreting VRAP Water Quality Parameters**

This appendix provides a brief description of water quality parameters typically sampled by VRAP volunteers and their importance, as well as applicable state water quality criteria or levels of concern.

■ **Appendix C – VRAP Volunteer Monitor Field Sampling Procedures Assessment (*Field Audits*)**

This appendix provides an overview of the VRAP Volunteer Monitor Field Sampling Procedures Assessment (field audit) process with respect to programmatic quality assurance/quality control (QA/QC) guidelines.

■ **Appendix D – New Hampshire Watershed Report Cards**

This appendix provides an overview of the New Hampshire Watershed Report Cards built from the 2008 305(b)/303(d) Surface Water Quality Reports.

■ **Appendix E – Biological Data**

This appendix includes a spreadsheet detailing biological data results including Order, common name, number of individuals found, group tolerance value, group biotic score, station biotic score, and narrative category.

■ **Appendix F – Habitat Data**

This appendix includes a spreadsheet detailing habitat data results such as surrounding land use, riparian habitat, in-stream characteristics, and erosion and other streamside impacts.

■ **Appendix G – Biological Sampling Methods**

This appendix details sampling methods in association with the New Hampshire Volunteer Biological Assessment Program.

2.0 PROGRAM OVERVIEW

2.1 What is VRAP?

In 1998, the New Hampshire Volunteer River Assessment Program was established to promote awareness and education of the importance of maintaining water quality in New Hampshire's rivers and streams. VRAP aims to educate people about river and stream water quality and ecology and to improve water quality monitoring coverage for the protection of water resources.

Today, VRAP loans water quality monitoring equipment, provides technical support, and facilitates educational programs to volunteer groups on numerous rivers and watersheds throughout the state. VRAP volunteers conduct water quality monitoring on an ongoing basis and increase the amount of river water quality information available to local, state and federal governments, which allows for better watershed planning.

2.2 Why is VRAP Important?

VRAP establishes a regular volunteer-driven water sampling program to assist NHDES in evaluating water quality throughout the state. VRAP empowers volunteers with information about the health of New Hampshire's rivers and streams. Regular collection of water quality data allows for early detection of water quality changes allowing NHDES to trace potential problems to their source. Data collected by VRAP volunteers are directly contributing to New Hampshire's obligations under the Clean Water Act. Measurements taken by volunteers are used in assessing the water quality of New Hampshire's river and streams, and are included in reporting to the US Environmental Protection Agency.

2.3 How Does VRAP Work?

VRAP is a cooperative program between NHDES, river groups, local advisory committees, watershed associations, and individuals working to protect New Hampshire's rivers and streams. Volunteers are trained by VRAP staff in the use of water quality monitoring equipment at an annual training workshop. VRAP works with each group to establish monitoring stations and develop a sampling plan.

During the summer months, VRAP receives water quality data from trained volunteers. The data are reviewed for quality assurance, and are entered into the environmental monitoring database at NHDES. During the off-season, VRAP interprets the data and compiles the results into an annual report for each river. VRAP volunteers can use the data as a means of understanding the details of water quality, as well as guide future sampling efforts. NHDES can use the data for making surface water quality assessments, provided that the data met certain quality assurance/quality control guidelines.

2.4 What is VBAP?

The Volunteer Biological Assessment Program (VBAP) was established in 2005 to supplement biological data collected by the New Hampshire Department of Environmental Services Biomonitoring Unit. The Biomonitoring program regularly collects detailed biological data in order to complete water quality assessments of wadeable streams. VBAP serves to educate the public about water quality issues as interpreted through biological data, build a constituency of volunteers to practice sound water quality management at a local level, and build public support for water quality protection.

Since the program's establishment in 2005, VBAP has continued to work closely with watershed volunteers throughout New Hampshire providing technical assistance, field supervision, training in biological monitoring protocols, educational outreach, and annual biological data collection reports. In 2007, VBAP collaborated with the Volunteer River Assessment Program building greater strength and capability for the future.

2.5 Equipment and Sampling Schedule

VRAP frequently lends and maintains water quality monitoring equipment kits to VRAP groups throughout the state. The kits contain meters and supplies for routine water quality parameter measurements of turbidity, pH, dissolved oxygen, water temperature and specific conductance (conductivity). Other parameters such as nutrients, metals, and *E. coli* can also be studied, although VRAP does not always provide funds to cover laboratory analysis costs. Thus, VRAP encourages groups to pursue other fundraising activities such as association membership fees, special events, in-kind services (non-monetary contributions from individuals and organizations), and grant writing.

Each year, volunteers design and arrange a sampling schedule in cooperation with VRAP staff. Project designs are created through a review and discussion of existing water quality information, such as known and perceived problem areas or locations of exceptional water quality. The interests, priorities, and resources of the partnership determine monitoring locations, parameters, and frequency. VRAP typically recommends sampling every other week from May through September, and VRAP groups are encouraged to organize a long-term sampling program in order to begin to determine trends in river conditions.

2.6 Training and Technical Support

Each VRAP volunteer attends an annual training workshop to receive a demonstration of monitoring protocols and sampling techniques and the calibration and use of water quality monitoring equipment. During the training, volunteers have an opportunity for hands-on use of the equipment and receive instruction in the collection of samples for laboratory analysis. NHDES also provides equipment, supplies and staff support for VRAP groups participating in biological assessment activities.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. For groups participating in biological assessment, each station is sampled once annually during the month of September. VRAP staff aim to visit each group annually during a scheduled sampling event to verify that volunteers successfully follow the VRAP protocols (see Appendix C). If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

Groups participating in biological assessment activities attend two training sessions prior to sampling. The first training session provides information on the biological monitoring protocol and aquatic invertebrate identification. The second session provides instruction in field methods. An NHDES staff person assists volunteers with all biological assessment activities during the sampling period.

2.7 Data Usage

Annual Water Quality Reports

Water quality measurements repeated over time create a picture of the fluctuating conditions in rivers and streams and help to determine where improvements, restoration or preservation may benefit the river and the communities it supports. All data collected by volunteers are summarized in water quality reports that are prepared and distributed after the conclusion of the sampling period. VRAP groups can use the reports and data as a means of understanding the details of water quality, guiding future sampling efforts, or determining restoration activities.

New Hampshire Surface Water Quality Assessments

Along with data collected from other water quality programs, specifically the State Ambient River Monitoring Program, applicable volunteer data are used to support periodic NHDES surface water quality assessments. VRAP data are entered into NHDES's environmental monitoring database and are ultimately uploaded to the EPA database. Assessment results and the methodology used to assess surface waters are published by NHDES every two years (i.e., Section 305(b) Water Quality Reports) as required by the federal Clean Water Act. The reader is encouraged to log on to the NHDES web page to review the assessment methodology and list of impaired waters <http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm/>.

2.8 Quality Assurance/Quality Control

In order for VRAP data to be used in the assessment of New Hampshire's surface waters, the data must meet quality control guidelines as outlined in the VRAP Quality Assurance Project Plan (QAPP). The VRAP QAPP was approved by NHDES and reviewed by EPA in the summer of 2003. The QAPP is reviewed annually and is officially updated and approved every five years. The VRAP quality assurance/quality control measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

- **Calibration:** Prior to each measurement, the pH and DO meters must be calibrated. Conductivity and turbidity meters are checked against a known standard before the first measurement and after the last one.
- **Replicate Analysis:** A second measurement by each meter is taken from the original sample at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the replicate analysis should be conducted at different stations. Replicates should be measured within 15 minutes of the original measurements.
- **6.0 pH Standard:** A reading of the pH 6.0 buffer is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the 6.0 pH standard check should be conducted at different stations.
- **Zero Oxygen Solution:** A reading of a zero oxygen solution is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the zero oxygen standard check should be conducted at different stations.
- **DI (De-Ionized) Turbidity Blank:** A reading of the DI blank is recorded at one of the stations during the sampling day. If the same sampling schedule is used throughout the monitoring season, the blank check should be conducted at different stations.
- **End of the Day Conductivity and Turbidity Meter Check:** At the conclusion of each sampling day, the conductivity and turbidity meters are re-checked against a known standard.

2.8.1 Measurement Performance Criteria

Precision is calculated for field and laboratory measurements through measurement replicates (instrumental variability) and is calculated for each sampling day. The use of VRAP data for assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as derived from equation 1, below. Any data exceeding the limits of the individual measures are disqualified from surface water quality assessments. All data that exceeds the limits defined by the VRAP QAPP are acknowledged in the data tables with an explanation of why the data was unusable. Table 1 shows typical parameters studied under VRAP and the associated quality control procedures.

(Equation 1. Relative Percent Difference)

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100 \%$$

where x_1 is the original sample and x_2 is the replicate sample

Table 1. Field Analytical Quality Controls

Water Quality Parameter	QC Check	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Measurement Replicate	RPD < 10% or Absolute Difference <0.8 C.	Repeat Measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement Replicate	RPD < 10%	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (Zero O ₂ Sol.)	RPD < 10% or Absolute Difference <0.4 mg/L	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Relative Accuracy
pH	Measurement Replicate	Absolute Difference <0.3 pH units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (pH = 6.0)	± 0.1 std units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement Replicate	RPD < 10% or Absolute Difference <5µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (Zero Air Reading)	± 5.0 µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Turbidity	Measurement Replicate	RPD < 10% or Absolute Difference <1.0 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (DI Water)	± 0.1 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Laboratory Parameters	Measurement Replicate	RPD < 20% or Absolute Difference less than ½ the mean value of the parameter in NHDES's Environmental Monitoring Database	Repeat Measurement	Volunteer Monitors	Precision

3.0 METHODS

During the summer of 1998, volunteers from the Exeter Conservation Commission began water quality monitoring in the Exeter River watershed. The goal of this effort was to provide water quality data relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life. The establishment of a long-term monitoring program will allow for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. NHDES has provided field training, equipment, financial assistance, and technical assistance.

During 2008, trained volunteers monitored water quality at 16 stations in the Exeter River watershed (Figure 1, Table 2). Stations IDs are designated using a number indicating the relative position of the station and a three-letter code to identify the waterbody name. The higher the station number the more upstream the station is in the watershed. All stations monitored during 2008 are designated as Class B waters.

Water quality monitoring was conducted monthly from May through September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters. Table 3 summarizes the parameters measured, standard methods, and equipment used.

In 2008, volunteers also conducted a biological assessment at nine stations in the Exeter River watershed. The goal of this effort is to complete screening level investigations of aquatic macroinvertebrate communities inhabiting the Exeter River watershed. Annual biological sampling at a designated station in the watershed can provide an indication of biological community condition, general water quality and overall watershed health as well as highlight changes that occur over time. The program serves to provide supplementary biological data to the NHDES Biomonitoring Program, enhancing state wide monitoring efforts and tracking potential problem areas needing further investigation. NHDES provides field training, equipment, financial assistance, and technical assistance.

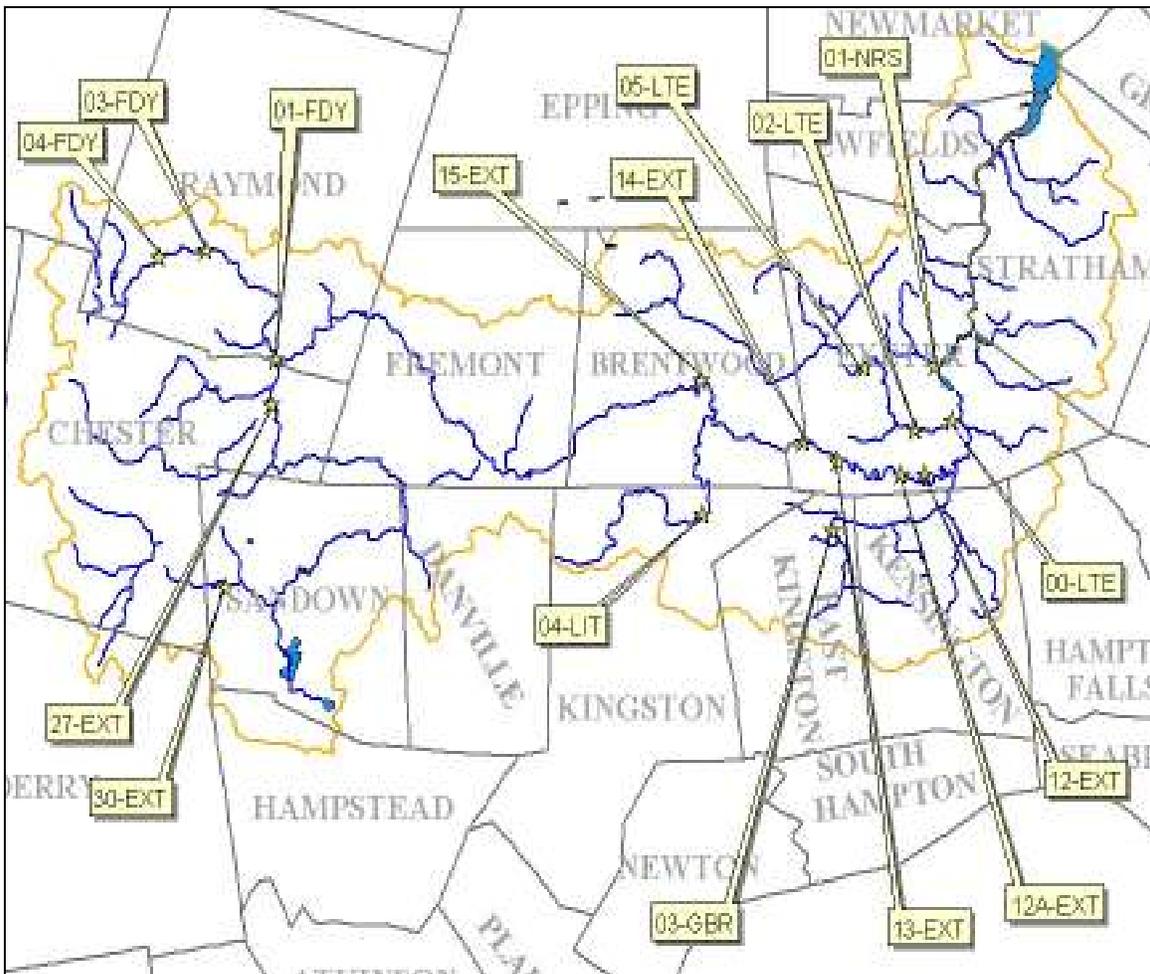
Table 2. Sampling Stations for the Exeter River Watershed, NHDES, 2008

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation <i>(Rounded to the Nearest 100 Feet)</i>
30-EXT NHRIV600030802-03	B	Exeter River	Wells Road	Sandown	300
27-EXT NHRIV600030802-05	B	Exeter River	Shepherd Home Road Bridge	Chester	200
04-FDY NHRIV600030801-05	B	Fordway Brook	Old Bye Road	Raymond	200
03-FDY NHRIV600030801-05	B	Fordway Brook	Lane Road Bridge	Raymond	200
01-FDY NHRIV600030801-05	B	Fordway Brook	Sandown Road	Raymond	200
15-EXT NHRIV600030803-05	B	Exeter River	Haigh Road	Brentwood	100
04-LIT NHRIV600030803-07	B	Little River	Little River Road	Kingston	100
14-EXT NHRIV600030805-02	B	Exeter River	Cross Road Bridge	Exeter	100
13-EXT NHRIV600030805-02	B	Exeter River	Kingston Road Bridge	Exeter	0
12A-EXT NHRIV600030805-02	B	Exeter River	Linden Street Bridge	Exeter	0
12-EXT NHRIV600030805-02	B	Exeter River	Route 108 Bridge	Exeter	0
03-GBR NHRIV600030805-04	B	Great Brook	Railroad Track off Giles Road	East Kingston	100
05-LTE NHRIV600030804-10	B	Little River	Garrison Road Bridge	Exeter	0
02-LTE NHRIV600030804-11	B	Little River	Linden Street Bridge	Exeter	0
00-LTE NHIMP600030805-04	B	Little River	Gilman Street Bridge	Exeter	0
01-NRS NHRIV600030806-02	B	Norris Brook	Water Street	Exeter	100

Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 95	-----
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 95	-----
pH	In-Situ	SM 4500 H+	Orion 210A+	-----
Turbidity	In-Situ	EPA 180.1	LaMotte 2020	-----
Specific Conductance	In-Situ	SM 2510	YSI 30	-----

Figure 1: Exeter River Watershed & Sampling Stations, 2008



RESULTS AND RECOMMENDATIONS

Results and recommendations for each monitored parameter are presented in the following sections. For a description of the importance of each parameter and pertinent water quality criteria for these and other parameters, please see Appendix B, *“Interpreting VRAP Water Quality Parameters.”*

4.1 Dissolved Oxygen

Between one and three measurements were taken in the field for dissolved oxygen concentration at 12 stations in the Exeter River watershed from Raymond to Exeter (Table 4). Of the 18 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire’s 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for dissolved oxygen includes a minimum concentration of 5.0 mg/L **and** a minimum daily average of 75 percent of saturation. In other words, there are criteria for both concentration and saturation that must be met before the river can be assessed as meeting dissolved oxygen standards. Table 4 reports only dissolved oxygen concentration as more detailed analysis is required to determine if instantaneous dissolved oxygen saturation measurements are above or below water quality standards.

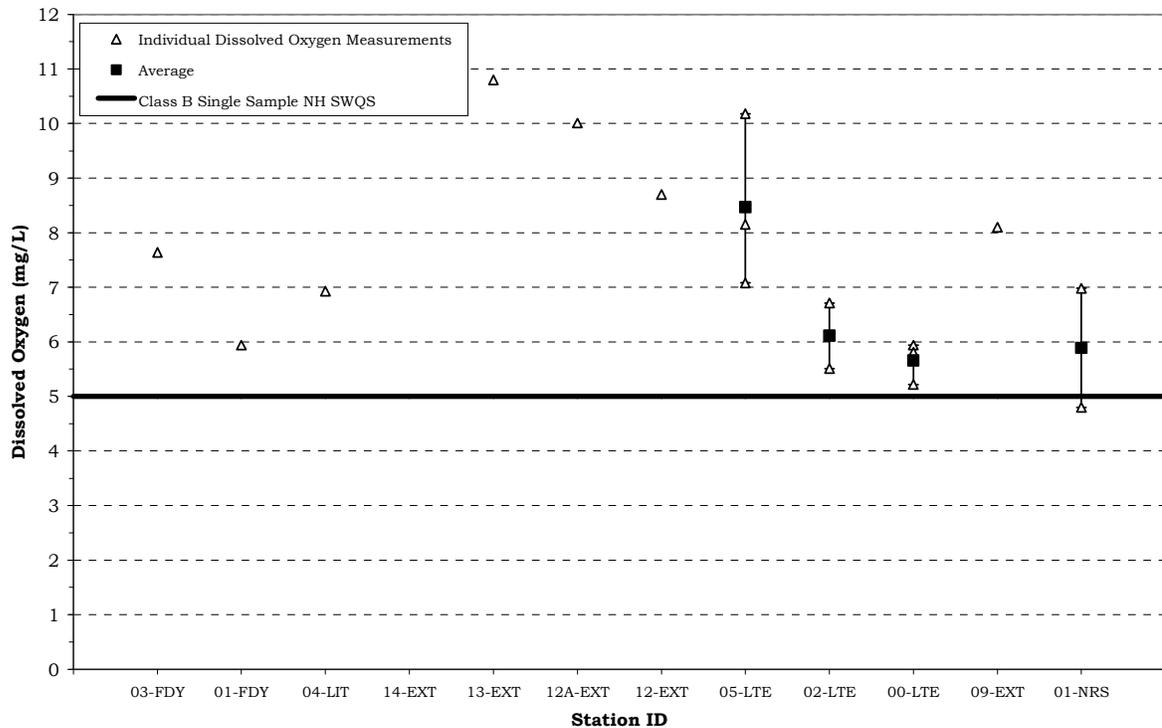
Table 4. Dissolved Oxygen Concentration (mg/L) Summary – Exeter River Watershed, 2008

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
03-FDY	1	7.64	0	1
01-FDY	1	5.94	0	1
04-LIT	1	6.93	0	1
14-EXT	1	11.2	0	1
13-EXT	1	10.8	0	1
12A-EXT	1	10.01	0	1
12-EXT	1	8.70	0	1
05-LTE	3	7.08 - 10.18	0	3
02-LTE	2	5.51 - 6.71	0	2
00-LTE	3	5.22 - 5.94	0	3
09-EXT	1	8.10	0	1
01-NRS	2	4.80 - 6.98	1	2
Total	18	—	1	18

All but one measurement (01-NRS) taken for dissolved oxygen concentration levels were above the New Hampshire Class B surface water quality standard. The average dissolved oxygen concentration ranged from 5.66 mg/L to 11.20 mg/L (Figure 2). Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

Stations where the instantaneous dissolved oxygen standard was not met could potentially have a dissolved oxygen problem and further investigation is warranted. It should be noted however, that low dissolved oxygen levels may be the result of natural conditions (e.g., the presence of wetlands or stagnant water caused by a beaver dam).

**Figure 2. Dissolved Oxygen Concentration Statistics for the Exeter River Watershed
July 5 - September 22, 2008, NHDES VRAP**



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- If possible, take measurements between 5 a.m. and 10 a.m., which is when dissolved oxygen is usually the lowest, and between 2 p.m. and 7 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.
- Continue incorporating the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.2 pH

Between one and three measurements were taken in the field for pH at 12 stations in the Exeter River watershed from Raymond to Exeter [Table 5]. Of the 23 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard is 6.5 - 8.0, unless naturally occurring.

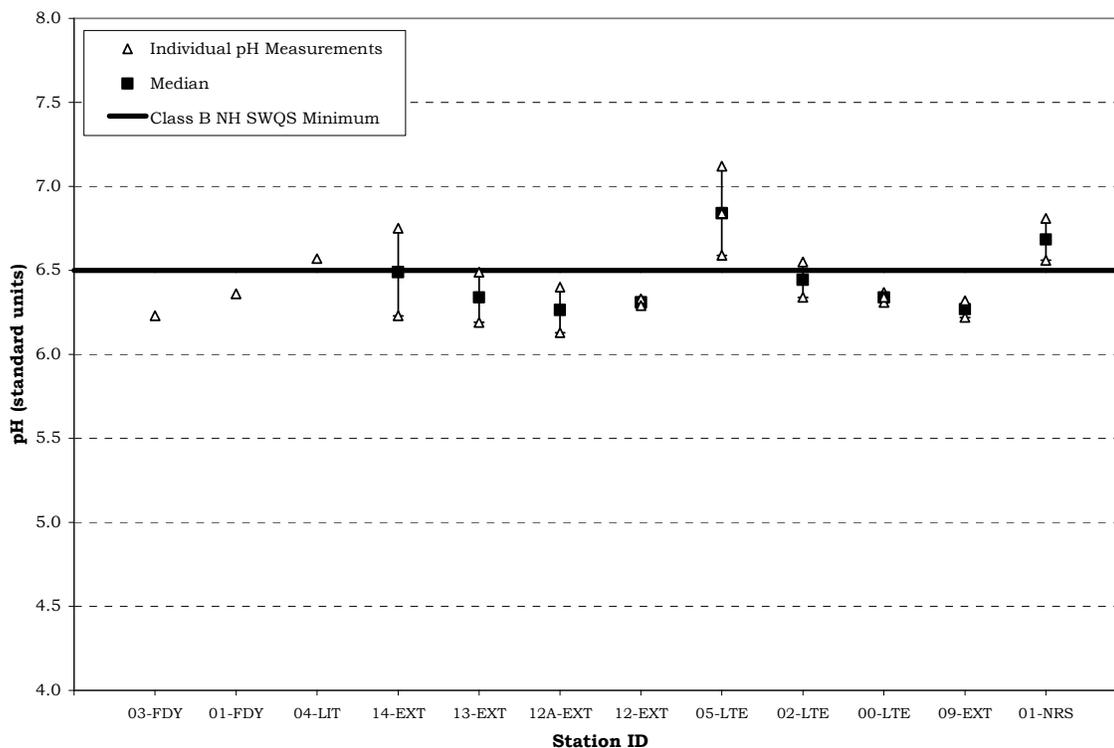
Table 5. pH Data Summary – Exeter River Watershed, 2008

Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
03-FDY	1	6.23	1	1
01-FDY	1	6.36	1	1
04-LIT	1	6.57	0	1
14-EXT	2	6.23 - 6.75	1	2
13-EXT	2	6.19 - 6.49	2	2
12A-EXT	2	6.13 - 6.40	2	2
12-EXT	2	6.29 - 6.33	2	2
05-LTE	3	6.59 - 7.12	0	3
02-LTE	2	6.34 - 6.55	1	2
00-LTE	3	6.31 - 6.37	3	3
09-EXT	2	6.22 - 6.32	2	2
01-NRS	2	6.56 - 6.81	0	2
Total	23	—	15	23

A majority of the pH measurements failed to meet the New Hampshire surface water quality standard minimum (Figure 3). However, pH measurements at stations 04-LIT, 01-NRS, and 05-LTE, and 01-NRS met the standard on all occasions.

Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally have a lower pH.

**Figure 3. pH Statistics for the Exeter River Watershed
July 5 - September 22, 2008, NHDES VRAP**



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Site conditions are considered along with pH measurements because of the narrative portion of the pH standard. RSA 485-A:8 states that pH of Class B waters *shall be between 6.5 and 8.0, except when due to natural causes*. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

4.3 Turbidity

Between one and three measurements were taken in the field for turbidity at 12 stations in the Exeter River watershed from Sandown to Exeter [Table 6]. Of the 23 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

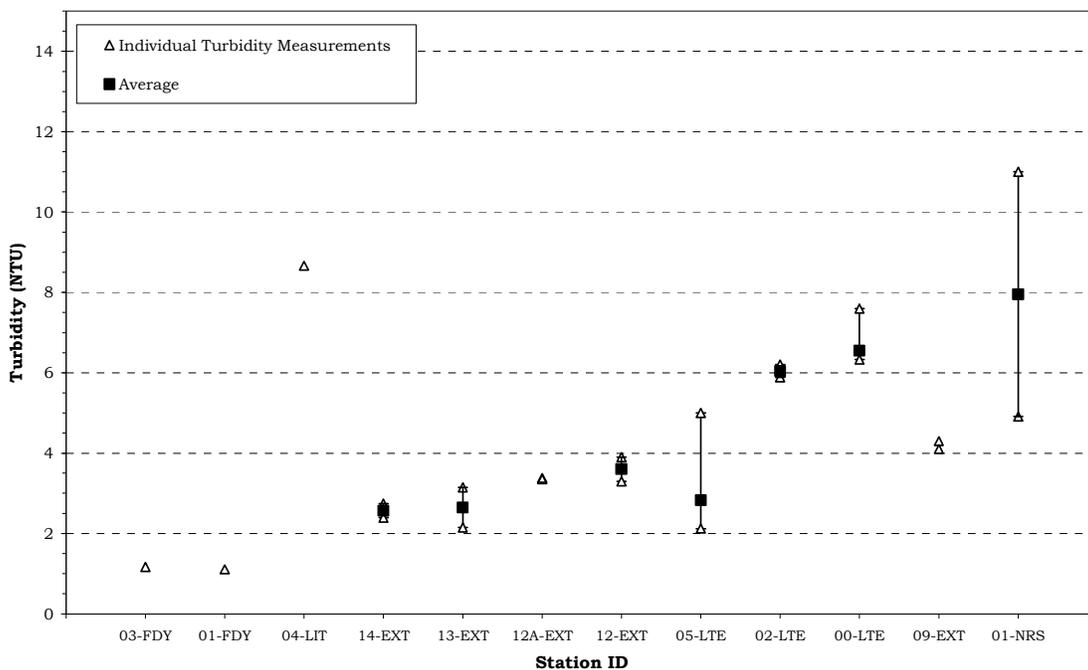
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above natural background.

Table 6. Turbidity Data Summary – Exeter River Watershed, 2008

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Potentially Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
03-FDY	1	1.17	0	1
01-FDY	1	1.11	0	1
04-LIT	1	8.66	0	1
14-EXT	2	2.40 - 2.74	0	2
13-EXT	2	2.15 - 3.15	0	2
12A-EXT	2	3.35 - 3.38	0	2
12-EXT	2	3.30 - 3.90	0	2
05-LTE	3	2.12 - 5.00	0	3
02-LTE	2	5.89 - 6.20	0	2
00-LTE	3	6.33 - 7.60	0	3
09-EXT	2	4.10 - 4.30	0	2
01-NRS	2	4.91 - 11.00	0	2
Total	23	—	0	23

Turbidity levels were low with the average ranging from 1.11 NTU to 8.66 NTU (Figure 4). In general, turbidity levels tended to increase throughout the watershed. Although clean waters are associated with low turbidity there is a high degree of natural variability involved. Precipitation often contributes to increased turbidity by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. However, human activities such as removal of vegetation near surface waters and disruption of nearby soils can lead to dramatic increases in turbidity levels. In general it is typical to see a rise in turbidity in more developed areas due to increased runoff.

**Figure 4. Turbidity Statistics for the Exeter River Watershed
July 5, - September 22, 2008, NHDES VRAP**



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Collect samples during wet weather. This will help us to understand how the river responds to runoff and sedimentation.
- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels, volunteers should contact NHDES.

4.4 Specific Conductance

Between one and three measurements were taken in the field for specific conductance at 12 stations in the Exeter River watershed from Sandown to Exeter [Table 7]. Of the 23 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

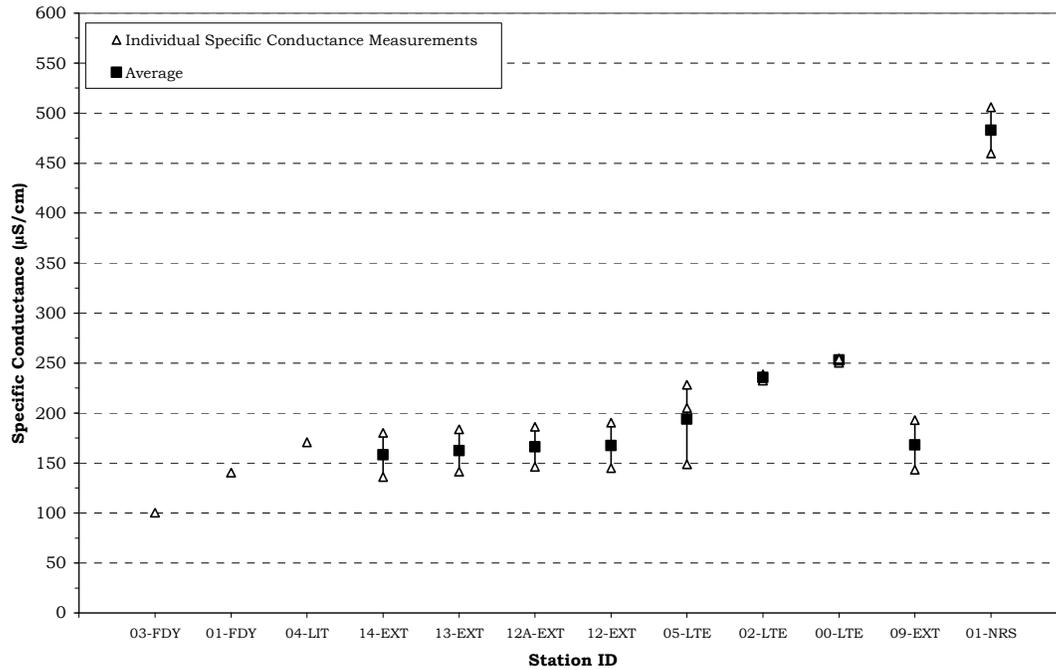
New Hampshire surface water quality standards do not contain numeric criteria for specific conductance although in many fresh surface waters, specific conductance can be used as a surrogate to predict compliance with numeric water quality criteria for chloride.

Table 7. Specific Conductance Data Summary – Exeter River Watershed, 2008

Station ID	Samples Collected	Data Range (µS/cm)	Acceptable Samples Not Meeting NH Class B Standards (µS/cm as chloride surrogate)	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
03-FDY	1	100.5	0	1
01-FDY	1	140.4	0	1
04-LIT	1	170.7	0	1
14-EXT	2	136.1 - 180.3	0	2
13-EXT	2	141.2 - 183.7	0	2
12A-EXT	2	146.2 - 186.2	0	2
12-EXT	2	144.9 - 190.2	0	2
05-LTE	3	148.6 - 228.3	0	3
02-LTE	2	232.4 - 238.6	0	2
00-LTE	3	250.1 - 254.4	0	3
09-EXT	2	143.2 - 193.0	0	2
01-NRS	2	459.7 - 506.0	0	2
Total	23	—	0	23

Specific conductance levels were variable and moderately high throughout the watershed with the average ranging from 100.2 µS/cm to 482.9 µS/cm (Figure 5). Higher specific conductance levels (> 200 µS/cm) can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the variable specific conductance levels indicate low pollutant levels at some stations and higher levels at others.

**Figure 5. Specific Conductance Statistics for the Exeter River Watershed
July 5 - September 22, 2008 NHDES VRAP**



Recommendations

- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.
- Consider collecting chloride samples at the same time that specific conductance is measured. During the late winter/early spring snowmelt, higher specific conductance levels are often seen due to elevated concentrations of chloride in the runoff. Specific conductance levels are very closely correlated to chloride levels. Simultaneously measuring chloride and specific conductance will allow for a better understanding of their relationship.
- Consider incorporating the use of in-situ dataloggers to automatically determine specific conductance levels during rain events, snowmelt, and baseline dry weather conditions. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.5 Water Temperature

Between one and three measurements were taken in the field for water temperature at 12 stations in the Exeter River watershed from Sandown to Exeter [Table 8]. Of the 23 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

Although there is currently no numerical water quality criteria for water temperature, NHDES is in the process of collecting biological and water temperature data that will contribute to the development of a procedure for assessing rivers and stream based on water temperature and its corresponding impact to the biological integrity of the waterbody.

Table 8. Water Temperature Data Summary – Exeter River Watershed, 2008

Station ID	Samples Collected	Data Range (°C)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
03-FDY	1	15.1	Not Applicable	1
01-FDY	1	13.5	N/A	1
04-LIT	1	14.2	N/A	1
14-EXT	2	10.8 - 22.7	N/A	2
13-EXT	2	10.9 - 22.3	N/A	2
12A-EXT	2	10.9 - 22.0	N/A	2
12-EXT	2	11.2 - 22.0	N/A	2
05-LTE	3	16.1 - 24.0	N/A	3
02-LTE	2	21.6 - 24.5	N/A	2
00-LTE	3	21.9 - 25.7	N/A	3
09-EXT	2	11.9 - 23.0	N/A	2
01-NRS	2	18.9 - 21.6	N/A	2
Total	23	_____	N/A	23

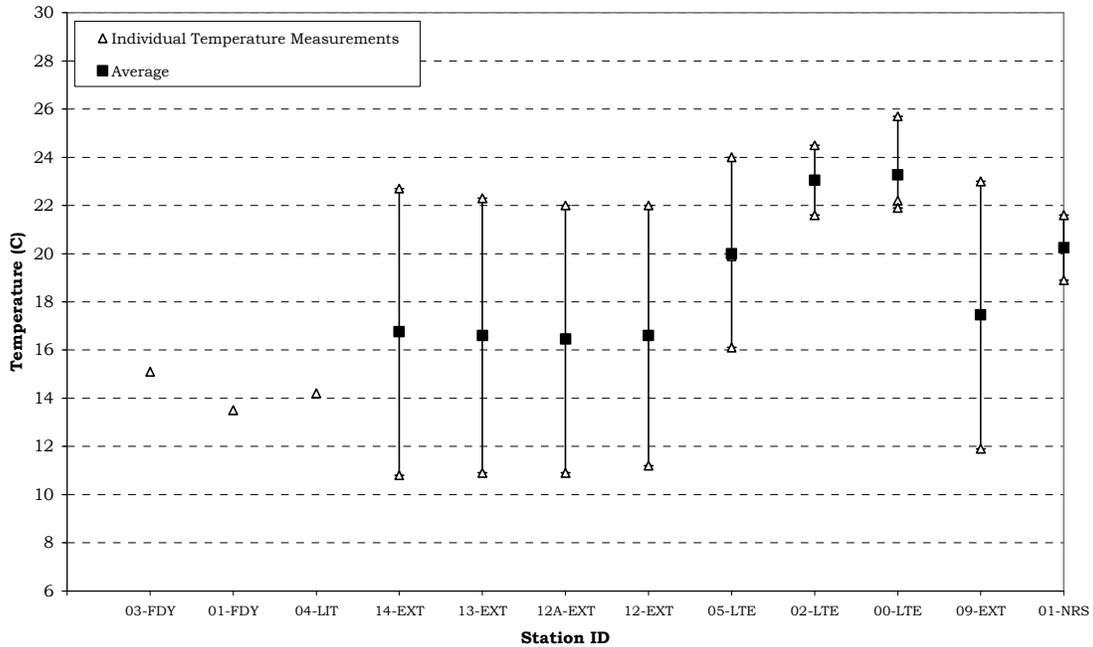
Figure 6 shows the results of instantaneous water temperature measurements taken at 17 stations in the Exeter River watershed. The average water temperature varied from 13.5 °C. to 23.3 °C.

Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and the activity of bacteria in the water. Water temperature controls the metabolic

and reproductive processes of aquatic species and can determine which fish and macroinvertebrate species can survive in a given river or stream.

A number of factors can have an impact on water temperature including the quantity and maturity of riparian vegetation along the shoreline, the rate of flow, the percent of impervious surfaces contributing stormwater, thermal discharges, impoundments and the influence of groundwater.

**Figure 6. Water Temperature Statistics for the Exeter River Watershed
July 5 - September 22, 2008 NHDES VRAP**



Recommendations

- Continue collecting water temperature data via both instantaneous readings and consider long-term deployment of NHDES water temperature dataloggers.

4.6 Biological Assessment

This section summarizes habitat and biological community condition data collected during the 2008 assessment season. A discussion of the results and recommendations for future actions is included.

Habitat Analysis

Surrounding land use, riparian habitat, and in-stream habitat were examined in the immediate observable area prior to collecting biological samples at each station. Findings were recorded on standardized data sheets included in the Volunteer Biological Assessment Program 2008 Draft Protocol.

Riparian Habitat

The surrounding land of all nine stations sampled in 2008 was composed of greater than 50 percent forest, two of which, 30-EXT and 27-EXT, were comprised entirely of forest. The total estimated width of the riparian zones varied widely, ranging from 20 feet to greater than 1,000 feet. At four of the nine stations the canopy covered between 40 and 75 percent of the stream. 03-FDY, 04-FDY and 03-GBT had a canopy covering greater than 75 percent of the stream, and two stations, 15-EXT and 01-FDY, had a canopy covering less than 40 percent of the stream. Deciduous trees comprised a majority (75%) of vegetative canopy composition.

In-stream Habitat

Extremely high waters were reported at most sampling stations. The United States Geological Survey (USGS) gauging station in the Exeter River recorded mean flows in the month of September at 145 cubic feet per second (cfs) in 2008 while in 2007 and 2006 mean flows were recorded at 3 and 32 respectively. Analysis revealed a statistically significant difference in mean September flows between 2006, 2007 and 2008 (One-way ANOVA; $F(2,81)=28.25$, $p<0.001$). In addition, the maximum flow in September of 2008 was recorded at 535 cfs while maximum flow in 2007 was recorded at only 9 cfs. All the stations were sampled during unusually high flows. In addition, 13-EXT and 02-TWL were removed from the sampling queue due to dangerously high flows.

Riffles were the most common habitat within seven of the nine sampling reaches. Water color was described as clear at six stations; cloudy water was reported at 04-LIT and “reddish/orange” water was reported at 03-GBR and 27-EXT. At most stations woody debris was present but not frequently encountered. The stream substrate was comprised primarily of cobble. Gravel and boulder substrates were observed less frequently. At seven of the nine stations the substrate was less than 50 percent embedded, and at 15-EXT and 05-LTE the substrate was embedded greater than 50 percent. At six stations, bank erosion was slight to moderate with only minor impacts to the stream suspected. No erosion was evident at 27-EXT and 30-EXT. Heavy erosion was reported at 04-FDY, where the eroded banks significantly impacted the streambed.

Biological Community Condition

Biotic scores ranged from 3.17 to 4.74, with a mean of 3.91, corresponding to the “good” category (Table 9). Of the eight stations sampled, three stations had a biotic score corresponding to the “excellent” category, while six stations had biotic scores corresponding to the “good” category, and no stations had biotic scores corresponding to the “fairly poor” category.

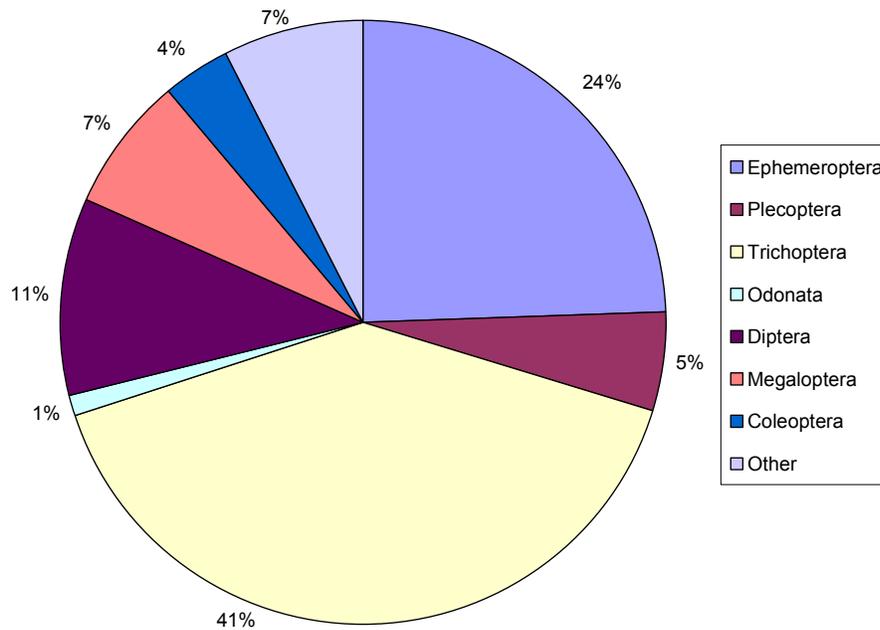
Table 9. Biological Data Summary - Exeter River Watershed, 2008.

Station ID	Biotic Score	Narrative Category	EPT (%)
30-EXT	3.81	Good	50.00%
27-EXT	4.74	Good	58.11%
04-FDY	3.17	Excellent	79.28%
03-FDY	3.46	Excellent	69.93%
01-FDY	3.33	Excellent	73.48%
15-EXT	4.34	Good	59.22%
04-LIT	3.94	Good	79.34%
03-GBR	4.37	Good	72.48%
05-LTE	4.02	Good	70.42%
Mean	3.91	Good	68.03%

The percentage of EPT individuals refers to the total percentage of Ephemeroptera (mayfly nymphs), Plecoptera (stonefly nymphs), and Trichoptera (caddisfly larvae) individuals in a sample. Generally, the percent of EPT individuals increases with increasing water quality. The percentage of EPT individuals in the Exeter River watershed ranged from 50.00 percent to 79.34 percent. Samples from 04-FDY and 04-LIT were comprised of greater than 75 percent EPT individuals. The mean percentage of EPT individuals in the watershed was 68.03 percent.

In 2008, a total of 1,641 macroinvertebrates from 15 taxonomic groups were collected and identified by volunteers in the Exeter River watershed. The number of individuals sorted at each station ranged from 103 to 284. The estimated macroinvertebrate abundance ranged from 161 to 596 individuals per sample. The most abundant taxonomic group in the watershed were the Trichoptorans (caddisfly larvae), comprising 41 percent of the total number of individuals collected (Figure 7). The “Other” group and Diptera (true flies) were also well represented in the total sample, accounting for 24 and 11 percent of the individuals, respectively.

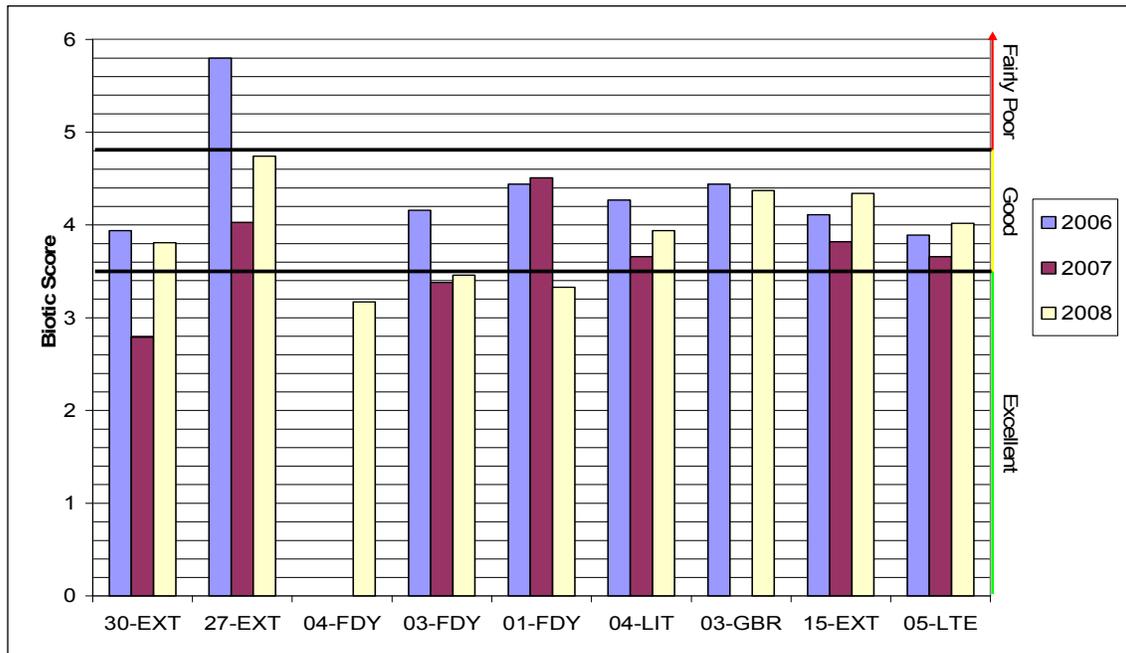
Figure 7. Biological Sample Composition Statistics - Exeter River Watershed, 2008.



Discussion

Compared to results from 2006 and 2007, no trend is readily apparent (Figure 8). In general, biotic scores have decreased from those obtained in 2006 and have increased from values obtained in 2007. On average, the range of biotic scores was within 0.8 points between 2006 and 2008. Changes in biotic score between 2007 and 2008 resulted in changes in narrative category at two stations, 30-EXT and 01-FDY. At 30-EXT, the 2007 biotic score corresponded to the “excellent” narrative category, while in 2008 it corresponded to the “good” category. At 01-FDY, the 2007 biotic score corresponded to the “good” narrative category, while in 2008 it corresponded to the “excellent” category.

Figure 8. Annual Biotic Scores – Exeter River Watershed, 2005-2008.



In 2008, mean abundance of macroinvertebrates in the Exeter River watershed was 359 individuals per station. This is lower than the mean abundances of both the 2007 (767) and 2006 (1,985) seasons.

Quality Control Test

To test the accuracy of volunteer identification skills and data validity, NHDES staff performed a quality control (QC) test of ten percent of the samples collected (i.e. one station). The Exeter River station 15-EXT was selected as the QC sample. Streamside identification yielded a biotic score of 4.34, corresponding to the “good” category. The QC analysis yielded a biotic score of 4.39, representing an increase of 0.05. A total of ten more individuals were counted in the QC analysis. Notable variations in composition include five fewer mayflies, and seven additional stoneflies and damselflies sorted in the QC analysis. In addition, seven additional “beetle or beetle-like” individuals were sorted, and seven fewer riffle beetles were sorted, possibly suggesting the volunteers may have confused the two.

Recommendations

- Continue annual sampling at all stations in order to develop a long-term data set to better understand trends.
- Assess the current biotic index and establish potential ways to further improve the rating scale

APPENDIX A: 2008 EXETER RIVER WATERSHED VRAP DATA

	Measurements not meeting New Hampshire surface water quality standards
	Measurements not meeting NHDES quality assurance/quality control standards

^A Water quality data collected in association with VBAP sampling

03-FDY, Fordway Brook, Lane Road Bridge, Raymond

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
9/12/2008 ^A	11:09	7.64	76.0	6.23	1.17	100.2	15.1

01-FDY, Fordway Brook, Sandown Road, Raymond

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
9/20/2008 ^A	10:00	5.94	57.3	6.36	1.11	140.4	13.5

04-LIT, Little River, Little River Road, Kingston

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
9/22/2008 ^A	09:15	6.93	66.5	6.57	8.66	170.7	14.2

14-EXT, Exeter River, Pickpocket Dam/Cross Road Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/05/2008	09:15			6.75	2.40	180.3	22.7
10/06/2008	09:35	11.20	98.8	6.23	2.74	136.1	10.8

13-EXT, Exeter River, Kingston Road (Route 111) Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/05/2008	09:40			6.49	2.15	183.7	22.3
10/06/2008	09:50	10.80	95.2	6.19	3.15	141.2	10.9

12A-EXT, Exeter River, Linden Street Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/05/2008	10:00			6.40	3.38	186.2	22.0
10/06/2008	10:05	10.01	90.6	6.13	3.35	146.2	10.9

12-EXT, Exeter River, Court Street/Route 108 Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/05/2008	10:20			6.33	3.30	190.2	22.0
10/06/2008	10:35	8.70	88.6	6.29	3.90	144.9	11.2

05-LTE, Little River, Garrison Road Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/10/2008	08:10	7.08	84.2	6.59	5.00	228.3	24.0
08/31/2008	09:30	8.15	89.5	6.84	2.83	204.9	19.9
9/22/2008 ^A	13:50	10.18	104.1	7.12	2.12	148.6	16.1

02-LTE, Little River, Linden Street Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/10/2008	08:40	5.51	60.1	6.34	6.20	238.6	24.5
08/31/2008	09:45	6.71	75.6	6.55	5.89	232.4	21.6

00-LTE, Little River, Gilman Street Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/10/2008	09:00	5.22	64.0	6.31	7.60	250.1	25.7
08/31/2008	10:00	5.94	67.9	6.34	6.55	254.4	22.2
08/31/2008	10:15	5.81	66.2	6.37	6.33	254.2	21.9

09-EXT, Exeter River, High Street Bridge, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/05/2008	10:40			6.22	4.10	193.0	23.0
10/06/2008	10:55	8.10	87.2	6.32	4.30	143.2	11.9

01-NRS, Norris Brook, Water Street, Exeter

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	NA	(µS/cm as chloride surrogate)	Narrative
07/10/2008	07:50	4.80	54.4	6.56	11.00	459.7	21.6
08/31/2008	10:30	6.98	73.4	6.81	4.91	506.0	18.9

APPENDIX B: Interpreting VRAP Water Quality Monitoring Parameters

Chemical Parameters

Dissolved Oxygen (DO)

- **Unit of Measurement:** concentration in milligrams per liter (mg/L) and percent saturation (%).
- **Description:** A measure of the amount of oxygen in the water: Concentration is a measure of the amount of oxygen in a volume of water; saturation is a measurement of the amount of oxygen in the water compared to the amount of oxygen the water can actually hold at full saturation. Both of these measurements are necessary to accurately determine whether New Hampshire surface water quality standards are met.
- **Importance:** Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action, or by rocky, steep, or uneven stream beds. The presence of dissolved oxygen is vital to bottom-dwelling organisms as well as fish and amphibians. Aquatic plants and algae produce oxygen in the water during the day, and consume oxygen during the night. Bacteria utilize oxygen both day and night when they process organic matter into smaller and smaller particles.

Class A NH Surface Water Quality Standard: 6 mg/L at any place or time, or 75% minimum daily average – (unless naturally occurring).

Class B NH Surface Water Quality Standard: 5 mg/L at any place or time or 75% minimum daily average – (unless naturally occurring).

Several measurements of oxygen saturation taken in a 24-hour period must be averaged to compare to the 75 percent daily average saturation standard. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the saturation has recovered to acceptable levels. Water can become saturated with more than 100 percent dissolved oxygen.

pH

- **Unit of Measurement:** units (no abbreviation).
- **Description:** A measure of hydrogen ion activity in water, or, in general terms, the acidity of water. pH is measured on a logarithmic scale of 0 to 14, with 7 being neutral. A high pH indicates alkaline (or basic) conditions and a low pH indicates acidic conditions. pH is influenced by geology and soils, organic acids (decaying leaves and other matter), and human-induced acids from acid rain (which typically has a pH of 3.5 to 5.5).
- **Importance:** pH affects many chemical and biological processes in the water and this is important to the survival and reproduction of fish and other aquatic life. Different organisms flourish within different ranges of pH. Measurements outside of an organism's preferred range can limit growth and reproduction and lead to physiological stress. Low pH can also affect the toxicity of aquatic compounds such as ammonia and certain metals by making them more "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life.

Class A NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Class B NH Surface Water Quality Standard: Between 6.5 and 8.0 (unless naturally occurring).

Sometimes, readings that fall below this range are determined to be naturally occurring. This is often a result of wetlands near the sample station. Wetlands can lower pH because the tannic and humic acids released by decaying plants can cause water to become more acidic.

pH Units	Category
<5.0	High Impact
5.0 – 5.9	Moderate to High Impact
6.0 – 6.4	Normal; Low Impact
6.5 – 8.0	Normal;
6.1 – 8.0	Satisfactory

Specific Conductance or Conductivity

- **Unit of Measurement:** micromhos per centimeter (umhos/cm) or microsiemens per centimeter (uS/cm).
- **Description:** The numerical expression of the ability of water to carry an electrical current at 25° C and a measure of free ion (charged particles) content in the water. These ions can come from natural sources such as bedrock, or human sources such as stormwater runoff. Specific conductance can be used to indicate the presence of chlorides, nitrates, sulfates, phosphates, sodium, magnesium, calcium, iron, and aluminum ions. There is a difference between conductivity and specific conductance. Specific conductance measures the free ion content of water at a *specific* water temperature, whereas conductivity measures the free ion content of water at 25° C. VRAP uses the term “specific conductance” because our conductivity measurements account for temperature. In some studies and programs, the term “conductivity” is used. This term should only be used when the measurement *does not* adjust to a specific temperature.
- **Importance:** Specific conductance readings can help locate potential pollution sources because polluted water usually has a higher specific conductance than unpolluted waters. High specific conductance values often indicate pollution from road salt, septic systems, wastewater treatment plants, or urban/agricultural runoff. Specific conductance can also be related to geology. In unpolluted rivers and streams, geology and groundwater are the primary influences on specific conductance levels.

Class A NH Surface Water Quality Standard: No numeric standard.

Class B NH Surface Water Quality Standard: No numeric standard.

Although there is no formal standard for specific conductance, data collect by VRAP groups and NHDES indicated a very close relationship between specific conductance levels and chloride. In some cases NHDES can use specific conductance measurements as a surrogate for chloride levels. The data collected by NHDES indicate that the chronic chloride standard is correlated with a specific conductance level of approximately 850 uS/cm.

Specific Conductance (uS/cm)	Category
0 – 100	Normal
101 – 200	Low Impact
201 – 500	Moderate Impact
> 501	High Impact
> 850	Likely exceeding chronic chloride standard

Turbidity

- **Unit of Measurement:** Nephelometric Turbidity Units (abbreviated as NTU).
- **Description:** A measurement of the amount of suspended material in the water. This material, which is comprised of particles such as clay, silt, algae, suspended sediment, and decaying plant material, causes light to be scattered and absorbed, rather than transmitted in straight lines through the water.
- **Importance:** Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces dissolved oxygen (DO) concentrations because warm water holds less DO than cold water. Higher turbidity also reduces the amount of light that can penetrate the water, which reduces photosynthesis and DO production. Suspended materials can clog fish gills, reducing disease resistance, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events can increase turbidity in surface waters by flushing sediment, organic matter and other materials into the water. Human activities such as vegetation removal and soil disruption can also lead to dramatic increases in turbidity levels.

Class A NH Surface Water Quality Standard: As naturally occurs.

Class B NH Surface Water Quality Standard: Shall not exceed naturally occurring conditions by more than 10 NTU.

Physical Parameters

Temperature

- **Unit of Measurement:** Degrees Celsius (° C)
- **Importance:** Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and bacteria activity in water. Water temperature controls the metabolic and reproductive processes of aquatic species and can determine which fish and macroinvertebrate species can survive in a given river or stream.

A number of factors can have an impact on water temperature including the quantity and maturity of riparian vegetation, the rate of flow, the percent of impervious surfaces contributing stormwater, thermal discharges, impoundments and groundwater.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard

Although there is currently no numerical water quality criteria for water temperature, NHDES is in the process of collecting biological and water temperature data that will contribute to the development of a procedure for assessing rivers and stream based on water temperature and its corresponding impact to the biological integrity of the waterbody.

Chlorophyll-a (Chlor a)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** An indicator of the biomass, or abundance, of planktonic algae in the river. The technical term “biomass” is used to represent “amount by weight.” Chlorophyll-a can be strongly influenced by phosphorus, which is derived by natural and human activities.

Importance: Because algae is a plant and contains the green pigment chlorophyll-a, the concentration of chlorophyll-a found in the water gives an estimation of the concentration of algae. If the chlorophyll-a concentration increases, this indicates an increase in the algal population.

Class A NH Surface Water Quality Standard: No numeric standard.

Class B NH Surface Water Quality Standard: No numeric standard.

Chlorophyll-a (mg/L)	Category
< 3	Excellent
3 – 7	Good
7 – 15	Less than desirable
> 15	Nuisance

Total Phosphorus (TP)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of all forms of phosphorus in the water, including inorganic and organic forms. There are many sources of phosphorus, both natural and human. These include soil and rocks, sewage, animal manure, fertilizer, erosion, and other types of contamination.
- **Importance:** Phosphorus is a nutrient that is essential to plants and animals. However, excess amounts can cause rapid increases in the biological activity in water. Phosphorus is usually the “limiting nutrient” in freshwater streams, which means relatively small amounts can increase algae and chlorophyll-a levels. Algal blooms and/or excessive aquatic plant growth can decrease oxygen levels and make water unattractive. Phosphorus can indicate the presence of septic systems, sewage, animal waste, lawn fertilizer, road and construction erosion, other types of pollution, or natural wetlands and atmospheric deposition.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard; as naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses.

Total Phosphorus (mg/L)	Category
< 0.010	Ideal
0.011 – 0.025	Average
0.026 – 0.050	More than desirable
> 0.051	Excessive (potential nuisance concentration)

Total Kjeldahl Nitrogen (TKN)

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** A measure of the amount of ammonia and organic nitrogen in the water.
- **Importance:** High nitrogen levels can increase algae and chlorophyll-a levels in the river, but is generally less of a concern in fresh water than phosphorus. Nitrogen can indicate the presence of sewage, animal waste, fertilizer, erosion, or other types of pollution.

Class A NH Surface Water Quality Standard: No numeric standard; as naturally occurs.

Class B NH Surface Water Quality Standard: No numeric standard; as naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses.

TKN (mg/L)	Category
< 0.25	Ideal
0.26 – 0.40	Average
0.41 – 0.50	More than desirable
> 0.51	Excessive (potential nuisance concentration)

Other Parameters

Chloride

- **Unit of Measurement:** Milligrams per liter (mg/L).
- **Description:** The chloride ion (Cl⁻) is found naturally in some surface waters and groundwater. It is also found in high concentrations in seawater. Higher-than-normal chloride concentrations in freshwater is detrimental to water quality. In New Hampshire, applying road salt for winter accident prevention is a large source of chloride to the environment. Unfortunately, this has increased over time due to road expansion and increased vehicle traffic. Road salt (most often sodium chloride) readily dissolves and enters aquatic environments in ionic forms. Although chloride can originate from natural sources, most of the chloride that enters the environment is associated with the storage and application of road salt. As such, chloride-containing compounds commonly enter surface water, soil, and groundwater during late-spring snowmelt (since the ground is frozen during much of the late winter and early spring). Sodium chloride is also used on foods as table salt, and consequently is present in human waste. Thus, sometimes chloride in water can indicate sewage pollution. Saltwater intrusion can also elevate groundwater chlorides in drinking water wells near coastlines. Chloride ions are conservative, which means they are not degraded in the environment and tend to remain in solution, once dissolved. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans.
- **Importance:** Research shows elevated chloride levels can be toxic to freshwater aquatic life. Among the species tested, freshwater aquatic plants and invertebrates tend to be the most sensitive to chloride. In order to protect freshwater aquatic life in New Hampshire, the state has adopted acute and chronic chloride criteria.

Acute Standard: 860 mg/L.

Chronic Standard: 230 mg/L.

Escherichia Coliform Bacteria (*E. coli*)

- **Unit of Measurement:** Counts per 100 milliliter (cts/100 mL).
- **Description:** An indicator of the potential presence of pathogens in fresh water. *E. coli* bacteria is a normal component in the large intestines of humans and other warm-blooded animals, and can be excreted in their fecal material. Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals.
- **Importance:** *E.coli* bacteria is a good indicator of fecal pollution and the possible presence of pathogenic organisms. In freshwater, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming.

Several factors can contribute to elevated *E. coli* levels, including, but not limited to rain storms, low river flows, the presence of wildlife, and the presence of septic systems along the river.

Class A NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 47 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 153 *E.coli* cts/100 mL in any one sample.

Class B NH Surface Water Quality Standard: Unless naturally occurring, shall contain not more than either a geometric mean of 126 *E.coli* cts/100 mL based on at least three samples obtained over a sixty-day period, or greater than 406 *E.coli* cts/100 mL in any one sample.

Metals

Depending on the metal concentration, its form (dissolved or particulate), and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on pH, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic.

Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. New Hampshire water quality regulations include numeric criteria for a variety of metals. Since dissolved metals are typically found in extremely low concentrations, the potential contamination of samples collected for trace metals analyses has become a primary concern of water quality managers. To prevent such contamination and to ensure reliable results, the use of “clean techniques” is becoming more and more frequent when sampling for dissolved metals. Because of this, sampling for metals may be more costly and require additional effort than in the past.

New Hampshire Volunteer River Assessment Program

29 Hazen Drive – PO Box 95
Concord, NH 03302-0095
p (603) 271-0699 – f (603) 271-7894
www.des.nh.gov

2008

APPENDIX C:

2008 VRAP Field Audit

On July 10, 2008 VRAP staff visited volunteers from the Exeter River VRAP group to conduct a field audit. VRAP staff aim to visit each group annually during a scheduled sampling event to verify that volunteers successfully follow the VRAP protocols. If necessary, volunteers are re-trained during the visit, and the group is notified of the result of the verification visit. During the visit, volunteers were assessed in the following five categories:

1) Overall Sampling Procedures

Appropriate storage of meters, sample collection, laboratory sample collection and transportation, beginning and end of day meter checks, collecting a field replicate, performing QA/QC Meter Checks, and ensuring that all calibration and sampling data are properly documented on the 2008 VRAP Field Data Sheet and the Laboratory Services Login & Custody Sheet.

2) Turbidity

Inspecting and cleaning of glass turbidity vials prior to measurement of standards and samples, performing the *Initial Turbidity Meter Check*, calibrating the meter to a known standard at the beginning of the sampling day, recording the value of the DI turbidity blank (*QA/QC Meter Check*) once during the sampling day, and performing the *End of the Day Meter Check* at the conclusion of the sampling day.

3) pH

Inspecting the pH electrode prior to sampling, calibrating to both pH 7.0 and 4.0 buffers prior to each measurement, rinsing and wiping the pH electrode probe prior to and after the measurement of standards and samples, allowing the pH measurement to stabilize prior to recording the measurement, and recording the value of the 6.0 buffer (*QA/QC Meter Check*) once during the sampling day.

4) Water Temperature/Dissolved Oxygen

Ensuring that the meter is allowed an adequate time to stabilize prior to the first calibration, the meter is calibrated prior to each measurement, the calibration value is properly recorded, the chamber reading is properly recorded, that sufficient time is allowed for readings to stabilize, and that a zero oxygen check (*QA/QC Meter Check*) is completed during the sampling day.

5) Specific Conductance

Performing the *Initial Conductivity Meter Check* using a known standard, allowing for the meter to properly stabilize before recording measurements, properly cleaning the probe between stations, and performing the *End of the Day Meter Check* at the conclusion of the sampling day.

During the field sampling procedures assessment, VRAP staff offered important reminders and suggestions to ensure proper sampling techniques and re-trained volunteers in the areas needing improvement. Afterwards, the volunteers were sent a follow-up e-mail providing written reminders and suggestions of the methods that need improvement. Overall, the Exeter River VRAP group did an excellent job. It is important to ensure that all volunteers attend an annual VRAP training workshop prior to the sampling season and to familiarize themselves with proper sampling techniques. Please remember to schedule an annual field audit in 2009.

APPENDIX D: New Hampshire Watershed Report Cards Built from the 2008 305(b)/303(d) Surface Water Quality Reports

305(b)/303(d) Integrated Report Background

<http://des.nh.gov/organization/divisions/water/wmb/swqa/>

The Surface Water Quality Assessment Program produces two surface water quality documents every two years, the "305(b) Report" and the "303(d) List". As the two documents use the same data and assessment methodology, the 305(b) Report and 303(d) List were combined into one Integrated Report. The Integrated Report describes the quality of New Hampshire's surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water.

Each Watershed Report Card covers a single 12 digit Hydrologic Unit Code (HUC12), on average a 34 square mile area. Each Watershed Report Card has three components;

1. **Report Card:** A one page card that summarizes the overall use support for Aquatic Life, Primary Contact (i.e. Swimming), and Secondary Contact (i.e. Boating) Designated Uses on every Assessment Unit ID (AUID) within the HUC12.
2. **HUC 12 Map:** A map of the watershed with abbreviated labels for each AUID within the HUC12.
3. **Assessment Details:** Anywhere from one to forty pages with the detailed assessment information for each and every AUID in the Report Card and Map.

How to Find Your HUC12 Watershed Report Card:

http://des.nh.gov/organization/divisions/water/wmb/swqa/report_cards.htm

then go to: <http://www2.des.nh.gov/SWQA>

TO FIND YOUR HUC12...

On the web, select your town of interest.

Town/City: ALEXANDRIA

- ACWORTH
- ALBANY
- ALEXANDRIA
- ALLENSTOWN
- ALSTEAD

Then the HUC12 of interest.

HUC 12	Name
010700010601	COCKERMOUTH RIVER
010700010602	HORNET COVE
010700010603	SANBORN BAY TO NEWFOUND R.
010700010701	SMITH RIVER UPPER
010700010702	SMITH RIVER LOWER

TIP! Turn off Pop-up Blockers to see the Report Card.

TIP! It may take a try or two to get the right area.

What are Assessment Units?

Each waterbody is divided into smaller segments called Assessment Units (AUs). In general, AUs are the basic unit of record for conducting and reporting the results of all water quality assessments. AUs are intended to be representative of homogenous segments; consequently, sampling stations within an AU can be assumed to be representative of the segment. Many factors can influence the homogeneity of a segment. Factors used to establish homogenous

AUs for assessments include: waterbody type, HUC12 boundaries, water quality standards, pollutant sources, Maximum AU size for rivers and streams, major changes in land use, stream order/location of major tributaries, public water supplies, outstanding resource waters, shellfish program categories, designated beaches, and cold water fish spawning areas.

Assessment Unit IDs (AUIDs) for each of the stations your group monitored in 2008 can be found in the sampling station table in this year’s VRAP report. Similarly, a list of all current and historic sampling stations for your group can be found on the VRAP webpage at <http://des.nh.gov/organization/divisions/water/wmb/vrap/index.htm>.

How are the Surface Water Quality Assessment Determinations Made?

All readily available data with reliable Quality Assurance/Quality Control is used in the biennial surface water quality assessments. For a full understanding of how the Surface Water Quality Standards (Env-Wq 1700) are translated into surface water quality assessments we urge the reader to review the 2008 Consolidated Assessment and Listing Methodology (CALM) at <http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm> (Appendices 4 & 5)

Where Can I find More Advanced Resources?

Additional resources including GIS shapefiles (Appendix 12) of all AUIDs in a sortable EXCEL file (Appendix 22) of the detailed assessments are available at <http://des.nh.gov/organization/divisions/water/wmb/swqa/2008/index.htm>.

How Are Assessments Coded in the Report Card?

Assessment outcomes are displayed on a color scale as well as an alpha numeric scale that provides additional distinctions for the designated use and Parameter level assessments as outlined in the table below.

		Severe	Poor	Likely Bad	No Data	Likely Good	Marginal	Good
		Not Supporting, Severe	Not Supporting, Marginal	Insufficient Information – Potentially Not Supporting	No Data	Insufficient Information – Potentially Full Supporting	Full Support, Marginal	Full Support, Good
Category	Description							
*Category 2	Meets standards						2-M or 2-OBS	2-G
Category 3	Insufficient Information			3-PNS	3-ND	3-PAS		
Category 4	Does not Meet Standards;							
4A	TMDL^ Completed	4A-P	4A-M or 4A-T					
4B	Other enforceable measure will correct the issue.	4B-P	4B-M or 4B-T					
4C	Non-pollutant (i.e. exotic weeds)	4C-P	4C-M					
Category 5	TMDL^ Needed	5-P	5-M or 5-T					

* “Category 1” only exists at the Assessment Unit Level.
 ^ TMDL stands for Total Maximum Daily Load studies (<http://des.nh.gov/organization/divisions/water/wmb/tmdl/index.htm>)

For More Information:

Ken Edwardson, NHDES Surface Water Quality Assessment Program Coordinator
 (603) 271-8864 - Kenneth.Edwardson@des.nh.gov

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030801

HUC 12 NAME WATSON BROOK

(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING
NHLAK600030801-01	L*01	NORTON POND	3-ND	3-ND	3-ND
NHLAK600030801-02	L*02	WASON POND	3-PAS	3-G	3-G
NHRIV600030801-01	R*01	FORDWAY BROOK	3-ND	3-ND	3-ND
NHRIV600030801-02	R*02	FORDWAY BROOK	3-ND	3-ND	3-ND
NHRIV600030801-03	R*03	UNNAMED BROOK - TO NORTON POND	3-ND	3-ND	3-ND
NHRIV600030801-04	R*04	UNNAMED BROOK - FROM NORTON POND TO UNNAMED POND	3-ND	3-ND	3-ND
NHRIV600030801-05	R*05	FORDWAY BROOK	5-P	3-ND	3-ND
NHRIV600030801-06	R*06	WASON BROOK - UNNAMED BROOK	3-PNS	3-ND	3-ND
NHRIV600030801-07	R*07	WASON BROOK	3-PNS	3-ND	3-ND
NHRIV600030801-08	R*08	UNNAMED BROOK - FROM UNNAMED POND TO EXETER RIVER	3-ND	3-ND	3-ND
NHRIV600030801-09	R*09	EXETER RIVER	3-ND	3-ND	3-ND
NHRIV600030801-10	R*10	EXETER RIVER	3-ND	3-PAS	3-PAS
NHRIV600030803-01	R*0803-01	EXETER RIVER	5-P	3-M	2-M

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030801

HUC 12 NAME WATSON BROOK

(Locator map on next page only applies to this HUC12)

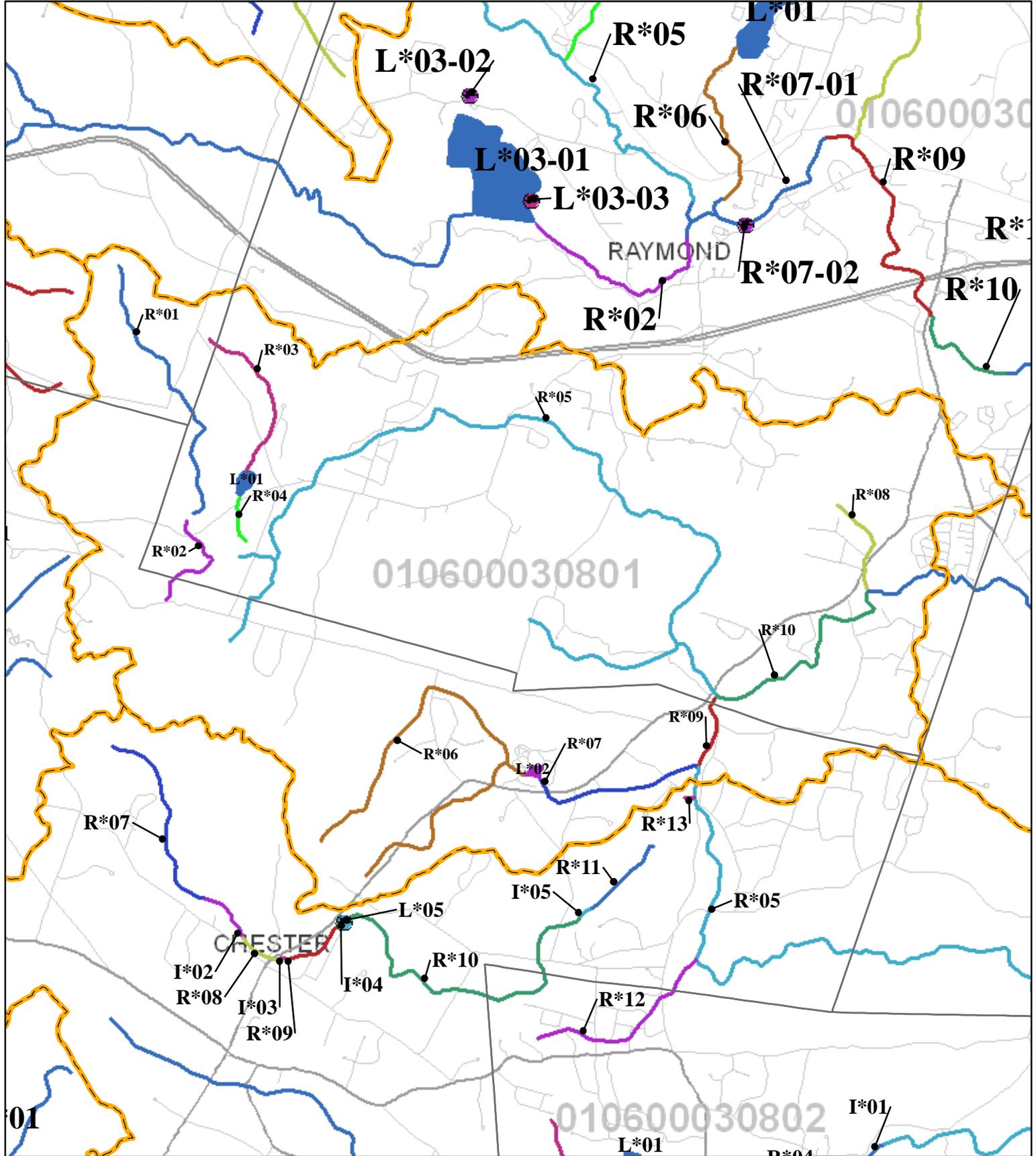
Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



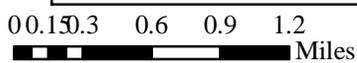
ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHLAK600030801-01	NORTON POND	3-ND	3-ND	3-ND	4A-M
NHLAK600030801-02	WASON POND	3-PAS	2-E	2-E	4A-M
NHRIV600030801-01	FORDWAY BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-02	FORDWAY BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-03	UNNAMED BROOK - TO NORTON POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-04	UNNAMED BROOK - FROM NORTON POND TO UNNAMED POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-05	FORDWAY BROOK	5-P	3-ND	3-ND	4A-M
NHRIV600030801-06	WASON BROOK - UNNAMED BROOK	3-PNS	3-ND	3-ND	4A-M
NHRIV600030801-07	WASON BROOK	3-PNS	3-ND	3-ND	4A-M
NHRIV600030801-08	UNNAMED BROOK - FROM UNNAMED POND TO EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-09	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030801-10	EXETER RIVER	3-ND	3-PAS	3-PAS	4A-M
NHRIV600030803-01	EXETER RIVER	5-P	3-M	2-M	4A-M

AUIDs for HUC12: 010600030801 - WATSON BROOK



Town Boundaries	Assessment Unit Coloring	4 =	Roads
HUC12 Boundaries		AUs Ending with:	
	0 =	5 =	State
	1 =	6 =	Local
	2 =	7 =	Private and Class 6
	3 =	8 =	
		9 =	

Scale: 1:52,763



Abbrev. Label	HUC 12
L*03	010 700060201

AUID = NH LAK700060201-03

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030802

HUC 12 NAME TOWLE BROOK-LILY POND

(Locator map on next page only applies to this HUC12)

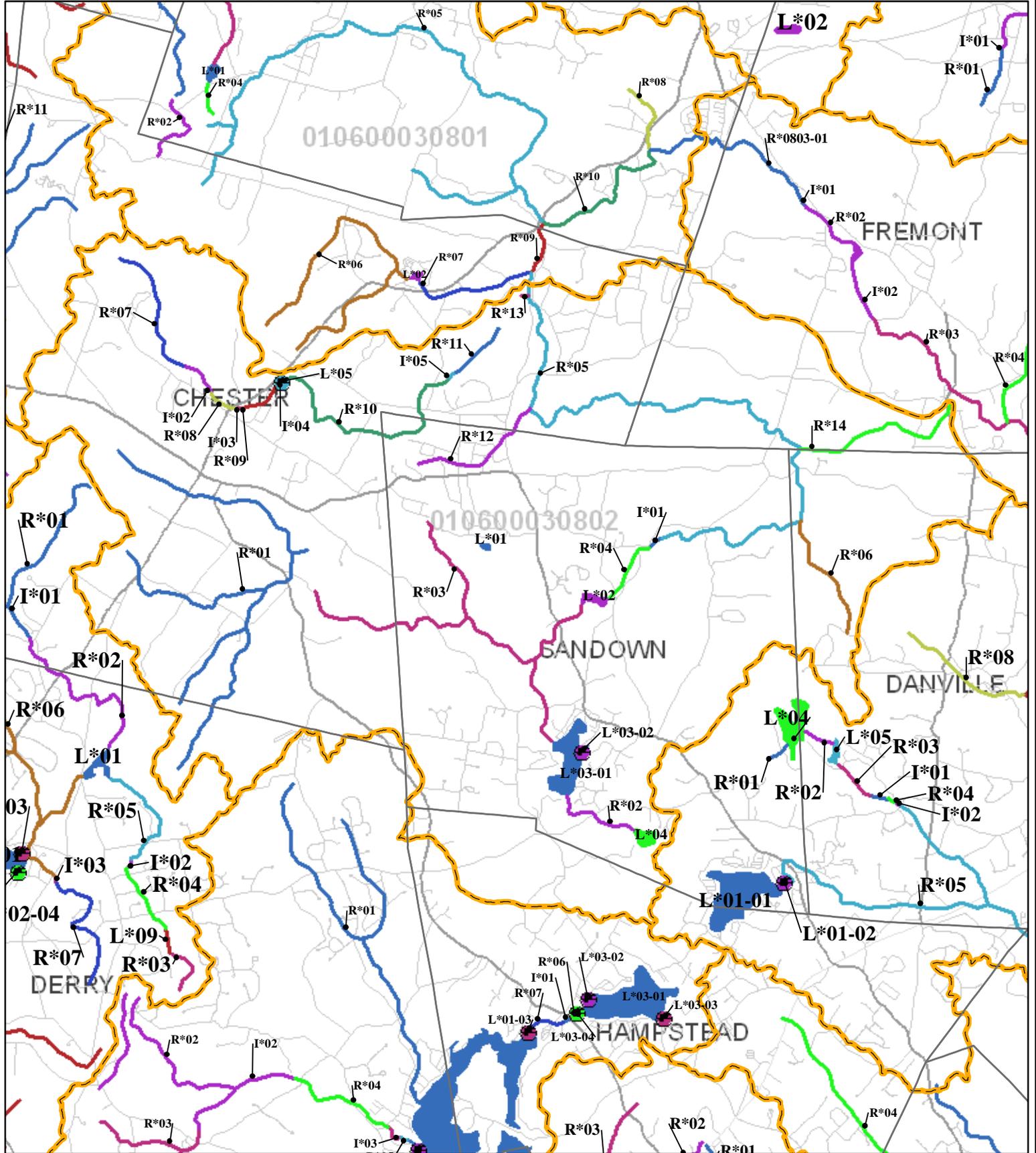
Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHIMP600030802-01	I*01	EXETER RIVER - DENSON POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030802-02	I*02	UNKNOWN RIVER - CHESTER TOWN DAM	3-ND	3-ND	3-ND	4A-M
NHIMP600030802-03	I*03	UNKNOWN RIVER - TOWLE BROOK	3-ND	3-ND	3-ND	4A-M
NHIMP600030802-04	I*04	UNKNOWN RIVER - EDWARDS MILL DAM	3-ND	3-ND	3-ND	4A-M
NHIMP600030802-05	I*05	UNKNOWN RIVER - PANDOLPHIN DAM	3-ND	3-ND	3-ND	4A-M
NHLAK600030802-01	L*01	HUNT POND	4A-M	3-PNS	3-ND	4A-M
NHLAK600030802-02	L*02	LILY POND	3-PNS	5-G	5-G	4A-M
NHLAK600030802-03-01	L*03-01	PHILLIPS POND	3-PNS	5-M	3-ND	4A-M
NHLAK600030802-03-02	L*03-02	PHILLIPS POND - SEELEY TOWN BEACH	3-PNS	5-M	5-G	4A-M
NHLAK600030802-04	L*04	SHOWELL POND	3-PNS	5-P	5-G	4A-M
NHLAK600030802-05	L*05	TOWLE BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-01	R*01	EXETER RIVER - WILSON BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-02	R*02	UNNAMED BROOK - FROM SHOWELL POND TO PHILLIPS POND	3-PAS	3-ND	3-ND	4A-M
NHRIV600030802-03	R*03	EXETER RIVER	3-M	5-P	2-M	4A-M
NHRIV600030802-04	R*04	EXETER RIVER	3-PAS	3-ND	3-ND	4A-M
NHRIV600030802-05	R*05	EXETER RIVER	3-PNS	3-ND	3-ND	4A-M
NHRIV600030802-06	R*06	UNNAMED BROOK - TO EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-07	R*07	TOWLE BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-08	R*08	TOWLE BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-09	R*09	TOWLE BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-10	R*10	TOWLE BROOK - TO PANDOLPIN DAM	3-PAS	5-P	2-M	4A-M
NHRIV600030802-11	R*11	TOWLE BROOK - FROM PANDOLPHIN DAM	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-12	R*12	UNNAMED BROOK - TO EXETER RIVER	3-PAS	3-ND	3-ND	4A-M
NHRIV600030802-13	R*13	TOWLE BROOK - TO EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030802-14	R*14	EXETER RIVER	3-ND	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600030802 - TOWLE BROOK-LILY POND



	Town Boundaries	Assessment Unit Coloring	4 =	Roads	
	HUC12 Boundaries				5 =
AUs Ending with:			6 =		State
0 =			7 =		Local
1 =			8 =		Private and Class 6
2 =			9 =		
3 =					

Scale: 1:74,825

0 0.20.4 0.8 1.2 1.6 Miles

<u>Abbrv. Label</u>	<u>HUC 12</u>
L*03	010 700060201
AUID = NH LAK700060201-03	

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030803

HUC 12 NAME SPRUCE SWAMP-LITTLE RIVER

(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING
NHIMP600030803-01	I*01	EXETER RIVER	3-ND	3-ND	3-ND
NHIMP600030803-02	I*02	EXETER RIVER	3-ND	3-ND	3-ND
NHIMP600030803-03	I*03	EXETER RIVER	3-ND	3-ND	3-ND
NHIMP600030803-04	I*04	LITTLE RIVER	3-ND	3-ND	3-ND
NHIMP600030803-05	I*05	LITTLE RIVER	3-ND	3-ND	3-ND
NHRIV600030803-01	R*0803-01	EXETER RIVER	5-P	3-N	2-M
NHRIV600030803-02	R*02	EXETER RIVER	3-ND	3-ND	3-ND
NHRIV600030803-03	R*03	EXETER RIVER	3-ND	3-ND	3-ND
NHRIV600030803-04	R*04	UNNAMED BROOK - TO EXETER RIVER	3-ND	3-ND	3-ND
NHRIV600030803-05	R*05	EXETER RIVER	5-P	3-PAS	3-ND
NHRIV600030803-06	R*06	LITTLE RIVER	3-PNS	3-ND	3-ND
NHRIV600030803-07	R*07	LITTLE RIVER	3-N	3-ND	3-ND
NHRIV600030803-08	R*08	LITTLE RIVER	3-PNS	3-ND	3-ND

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030803

HUC 12 NAME SPRUCE SWAMP-LITTLE RIVER

(Locator map on next page only applies to this HUC12)

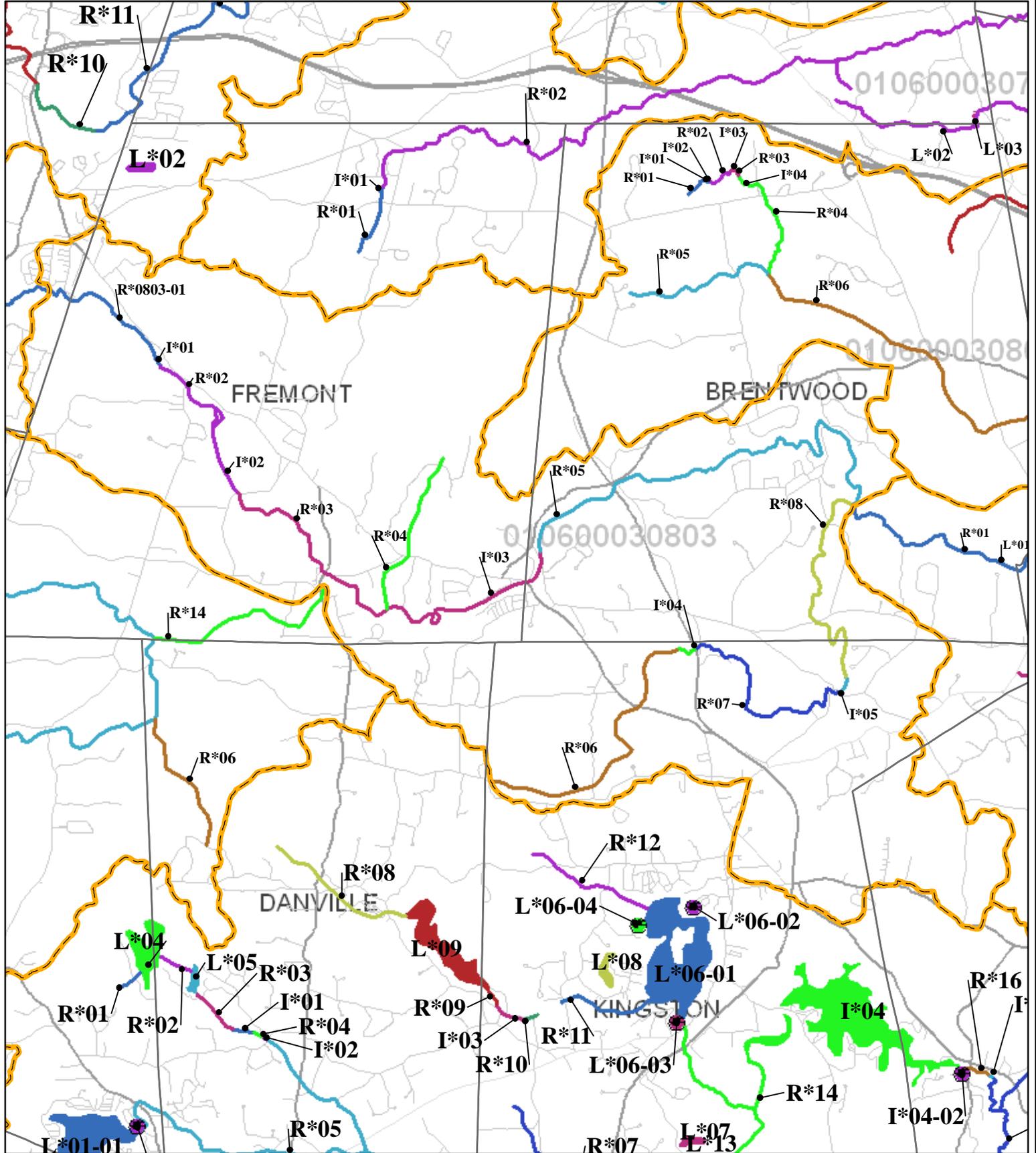
Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHIMP600030803-01	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600030803-02	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600030803-03	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600030803-04	LITTLE RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600030803-05	LITTLE RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030803-01	EXETER RIVER	5-P	3-M	2-M	4A-M
NHRIV600030803-02	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030803-03	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030803-04	UNNAMED BROOK - TO EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030803-05	EXETER RIVER	5-P	3-PAS	3-ND	4A-M
NHRIV600030803-06	LITTLE RIVER	3-PNS	3-ND	3-ND	4A-M
NHRIV600030803-07	LITTLE RIVER	3-M	3-ND	3-ND	4A-M
NHRIV600030803-08	LITTLE RIVER	3-PNS	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600030803 - SPRUCE SWAMP-LITTLE RIVER



	Town Boundaries	Assessment Unit Coloring	4 =	Roads	
	HUC12 Boundaries				5 =
AUs Ending with:			6 =		State
0 =			7 =		Local
1 =			8 =		Private and Class 6
2 =			9 =		
3 =					

Scale: 1:66,526

0 0.2 0.4 0.8 1.2 1.6 Miles

<u>Abbrev. Label</u>	<u>HUC 12</u>
L*03	010 700060201
AUID = NH LAK700060201-03	

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030805

HUC 12 NAME GREAT BROOK-EXETER RIVER

(Locator map on next page only applies to this HUC12)

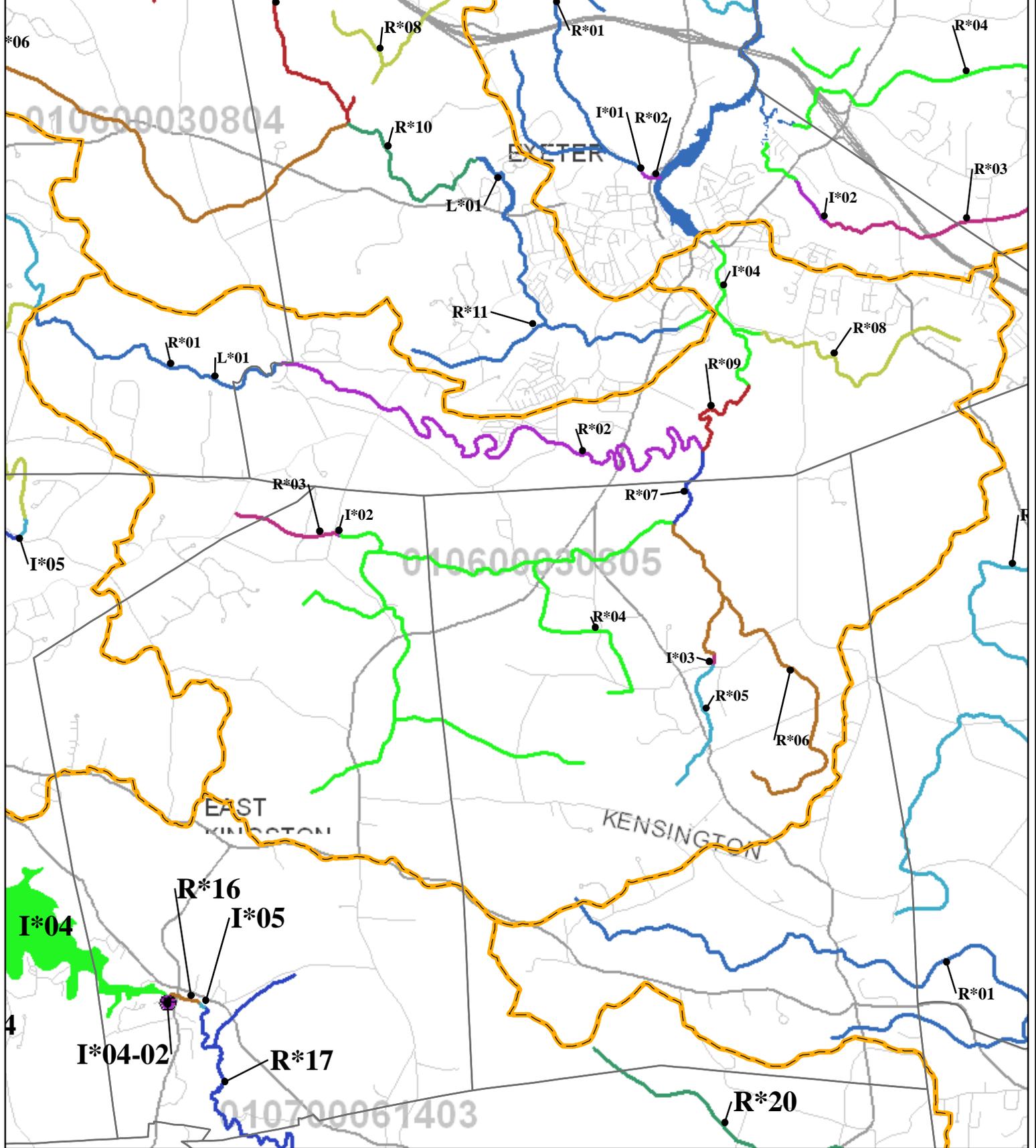
Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHEST600030806-01	E*01	SQUAMSCOTT RIVER	5-P	5-P	5-P	3-N
NHIMP600030805-02	I*02	BRICKYARD BROOK - BLUNT POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030805-03	I*03	UNKNOWN RIVER - PHILBRICK POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030805-04	I*04	EXETER RIVER - EXETER RIVER DAM I	5-P	5-P	5-M	4A-M
NHLAK600030805-01	L*01	PICKPOCKET POND	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-01	R*01	EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-02	R*02	EXETER RIVER	5-P	5-P	2-G	4A-M
NHRIV600030805-03	R*03	BRICKYARD BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-04	R*04	GREAT BROOK - BRICKYARD BROOK - HOBBS BROOK - YORK BROOK	5-P	5-P	2-M	4A-M
NHRIV600030805-05	R*05	UNNAMED BROOK - TO PHILLBRICK POND	3-PAS	3-ND	3-ND	4A-M
NHRIV600030805-06	R*06	UNNAMED BROOK - FROM PHILLBRICK POND TO GREAT BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-07	R*07	GREAT BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-08	R*08	UNNAMED BROOK - TO EXETER RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030805-09	R*09	EXETER RIVER	5-P	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600030805 - GREAT BROOK-EXETER RIVER



Town Boundaries	Assessment Unit Coloring	4 =	Roads
HUC12 Boundaries		5 =	
	AUs Ending with:	6 =	State
	0 =	7 =	Local
	1 =	8 =	Private and Class 6
	2 =	9 =	
	3 =		

Scale: 1:54,534

0.0 0.3 0.6 0.9 1.2 Miles

<u>Abbrv. Label</u>	<u>HUC 12</u>
	010 <u>700060201</u>
AUID = NH <u>LAK700060201-03</u>	

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030806

HUC 12 NAME SQUAMSCOTT RIVER

(Locator map on next page only applies to this HUC12)

Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



ASSESSMENT UNIT ID	MAP LABEL	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING
NHEST600030806-01	E*01	SQUAMSCOTT RIVER	5-P	5-P	5-P
NHEST600030904-02	E*0904-02	GREAT BAY PROHIB SZ1	5-P	5-P	5-G
NHIMP600030806-01	I*01	NORRIS BROOK - FARM POND	3-ND	3-ND	3-ND
NHIMP600030806-02	I*02	WHEELWRIGHT CREEK - EXETER RESERVOIR	3-PAS	3-PAS	3-PAS
NHIMP600030806-03	I*03	PARTING BROOK	3-ND	3-ND	3-ND
NHIMP600030806-04	I*04	MILL BROOK - MILL BROOK POND	3-PAS	3-ND	3-ND
NHRIV600030806-01	R*01	NORRIS BROOK	3-PAS	5-P	5-M
NHRIV600030806-02	R*02	NORRIS BROOK	3-ND	3-PAS	3-PAS
NHRIV600030806-03	R*03	WHEELWRIGHT CREEK	3-ND	3-ND	3-ND
NHRIV600030806-04	R*04	WHEELWRIGHT CREEK - PARKMAN BROOK	5-M	5-P	2-M
NHRIV600030806-05	R*05	ROCKY HILL BROOK	3-ND	3-ND	3-ND
NHRIV600030806-06	R*06	UNNAMED BROOK - TO SQUAMSCOTT RIVER	3-ND	3-ND	3-ND
NHRIV600030806-07	R*07	PARTING BROOK	3-ND	3-ND	3-ND
NHRIV600030806-08	R*08	PARTING BROOK	3-PAS	2-M	5-G
NHRIV600030806-09	R*09	UNNAMED BROOK - TO SQUAMSCOTT RIVER	5-M	5-M	2-M
NHRIV600030806-10	R*10	MILL BROOK	3-ND	3-ND	3-ND
NHRIV600030806-11	R*11	MILL BROOK	3-PNS	3-PNS	3-ND
NHRIV600030806-12	R*12	JEWELL HILL BROOK	3-ND	3-ND	3-ND
NHRIV600030806-13	R*13	UNNAMED BROOK - TO GREAT BAY	3-ND	3-ND	3-ND
NHRIV600030806-14	R*14	TRIBUTARY TO SQUAMSCOTT RIVER - STUART DAIRY FARM	3-ND	5-M	3-ND
NHRIV600030806-15	R*15	TRIBUTARY TO SQUAMSCOTT RIVER - SCAMMAN DAIRY FARM	3-ND	3-PAS	5-G

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600030806

HUC 12 NAME SQUAMSCOTT RIVER

(Locator map on next page only applies to this HUC12)

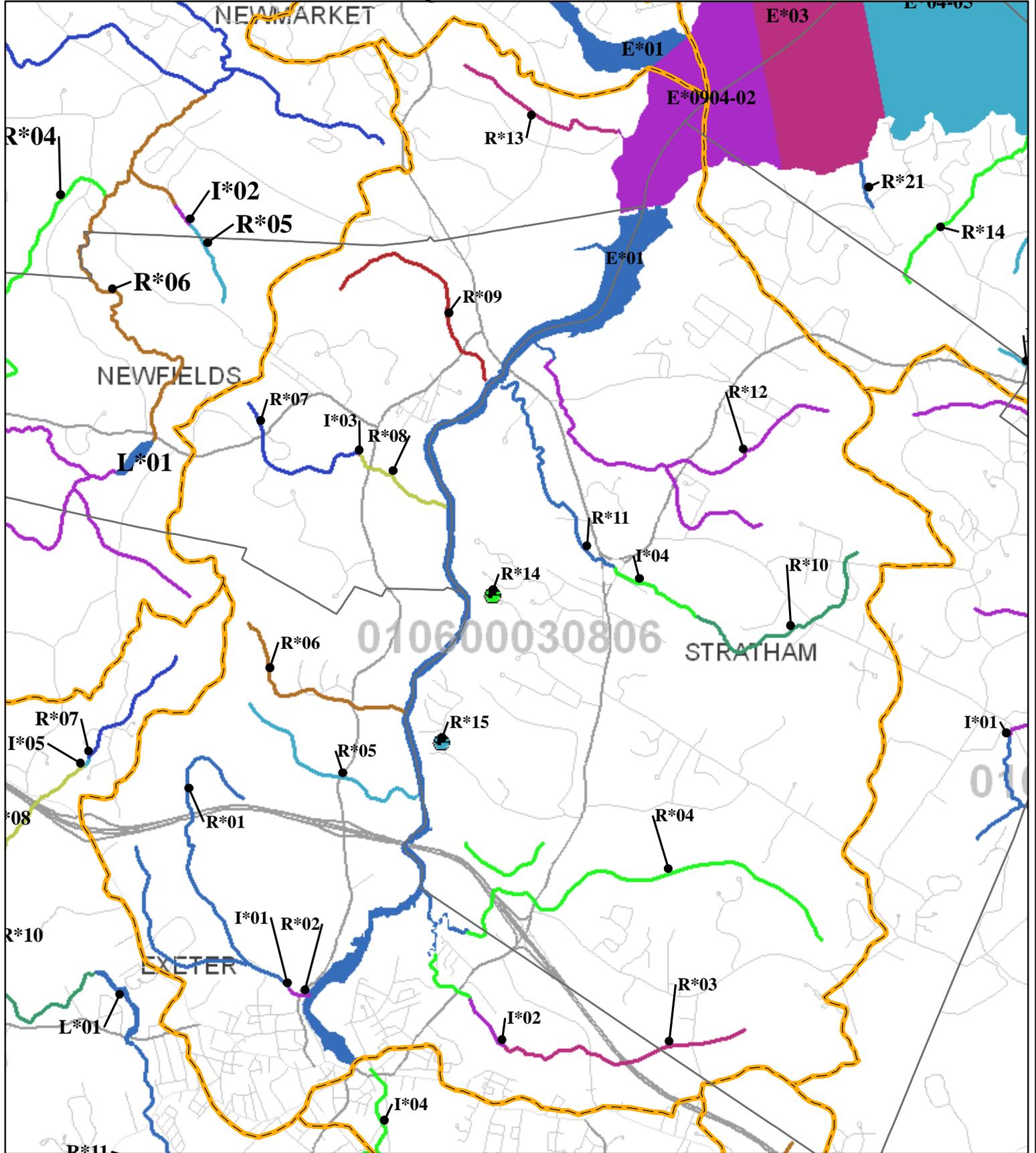
Assessment Cycle 2008

Good	Full Support Good
Marginal	Full Support Marginal
Likely Good	Insufficient Information – Potentially Full Support
No Data	No Data
Likely Bad	Insufficient Information – Potentially Not Support
Poor	Not Support Marginal
Severe	Not Support Severe



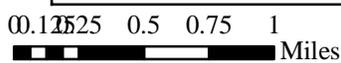
ASSESSMENT UNIT ID	ASSESSMENT UNIT NAME	AQUATIC LIFE	SWIMMING	BOATING	FISH CONSUMP.
NHEST600030806-01	SQUAMSCOTT RIVER	5-P	5-P	5-P	3-M
NHEST600030904-02	GREAT BAY PROHIB SZ1	5-P	5-P	5-P	3-M
NHIMP600030806-01	NORRIS BROOK - FARM POND	3-ND	3-ND	3-ND	4A-M
NHIMP600030806-02	WHEELWRIGHT CREEK - EXETER RESERVOIR	3-PAS	3-PAS	3-PAS	4A-M
NHIMP600030806-03	PARTING BROOK	3-ND	3-ND	3-ND	4A-M
NHIMP600030806-04	MILL BROOK - MILL BROOK POND	3-PAS	3-ND	3-ND	4A-M
NHRIV600030806-01	NORRIS BROOK	3-PAS	5-P	3-M	4A-M
NHRIV600030806-02	NORRIS BROOK	3-ND	3-PAS	3-PAS	4A-M
NHRIV600030806-03	WHEELWRIGHT CREEK	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-04	WHEELWRIGHT CREEK - PARKMAN BROOK	5-M	5-P	2-M	4A-M
NHRIV600030806-05	ROCKY HILL BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-06	UNNAMED BROOK - TO SQUAMSCOTT RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-07	PARTING BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-08	PARTING BROOK	3-PAS	2-M	5-P	4A-M
NHRIV600030806-09	UNNAMED BROOK - TO SQUAMSCOTT RIVER	5-M	5-M	2-M	4A-M
NHRIV600030806-10	MILL BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-11	MILL BROOK	3-PNS	3-PNS	3-ND	4A-M
NHRIV600030806-12	JEWELL HILL BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-13	UNNAMED BROOK - TO GREAT BAY	3-ND	3-ND	3-ND	4A-M
NHRIV600030806-14	TRIBUTARY TO SQUAMSCOTT RIVER - STUART DAIRY FARM	3-ND	5-M	3-ND	4A-M
NHRIV600030806-15	TRIBUTARY TO SQUAMSCOTT RIVER - SCAMMAN DAIRY FARM	3-ND	3-PAS	5-P	4A-M

AUIDs for HUC12: 010600030806 - SQUAMSCOTT RIVER



Town Boundaries	Assessment Unit Coloring	4 =	Roads
HUC12 Boundaries		5 =	
	AUs Ending with:	6 =	State
	0 =	7 =	Local
	1 =	8 =	Private and Class 6
	2 =	9 =	
	3 =		

Scale: 1:46,581



<u>Abbrv. Label</u>	<u>HUC 12</u>
L*03	010 700060201
AUID = NH LAK700060201-03	

Appendix E: 2008 Exeter River Watershed Biological Data

Order	Common Name	Tolerance Value	30-EXT	27-EXT	04-FDY	03-FDY	01-FDY	04-LIT	15-EXT	03-GBR	05-LTE
Ephemeroptera	Mayfly Nymph	3	9	54	30	63	9	82	26	8	118
Plecoptera	Stonefly Nymph	1	15	2	40	1	8	0	14	3	4
Trichoptera	Caddisfly Larvae	4	51	30	129	43	80	133	21	97	78
Odonata	Dragonfly Nymph	7	1	3	5	2	0	2	2	0	2
	Damselfly Nymph	3	0	0	0	0	0	0	0	0	0
Diptera	Black Fly Larvae	7	13	14	1	11	1	30	6	6	23
	Midge Larvae	6	0	4	0	0	1	1	0	0	2
	Most True Flies	4	28	3	14	2	6	1	2	4	1
Megaloptera	Alderfly	4	0	0	0	0	0	0	0	0	0
	Fishfly Larvae or Hellgrammite	0	18	5	25	22	21	15	1	6	5
Coleoptera	Beetle & Beetle-like	7	0	1	0	0	0	0	0	6	8
	Riffle Beetle	4	0	0	0	1	0	0	9	1	1
	Water Penny	4	1	0	1	0	0	0	1	3	29
Other	Aquatic Worms	8	14	0	6	5	0	3	7	15	2
	Clams & Mussels	7	0	0	0	0	0	0	0	0	0
	Crayfish	7	0	0	0	0	0	0	0	0	0
	Scuds	8	0	31	0	3	6	4	13	0	11
	Snails	7	0	0	0	0	0	0	1	0	0
	Sowbug	7	0	1	0	0	0	0	0	0	0
Total Macroinvertebrates			150	148	251	153	132	271	103	149	284
Biotic Score			3.81	4.74	3.17	3.46	3.33	3.94	4.34	4.37	4.02
VBAP Narrative Category			Good	Good	Excellent	Excellent	Excellent	Good	Good	Good	Good
% EPT			50.00%	58.11%	79.28%	69.93%	73.48%	79.34%	59.22%	72.48%	70.42%
Estimated Abundance			200	296	418	161	176	542	275	596	568

Appendix F: 2008 Exeter River Watershed Habitat Data

Station ID	Surrounding Land Use	RIPARIAN HABITAT			IN-STREAM CHARACTERISTICS				Erosion & Other Streamside Impacts
		Dominant Vegetative Type	Width of Riparian Zone (ft)	% Canopy Cover % tree type	Most Prevalent Habitat Type	Water Color/ Stream Flow	Substrate/ % Embeddedness	Aquatic Vegetation	
30-EXT	Forest	Trees	L: >500 R: >500	40-75% 80% D 20% C	Riffles	Clear High	Gravel (20%) Cobble (70%) Boulder (10%) 25-50%	Moss	No erosion evident
27-EXT	Forest	Trees Shrubs	L: >500 R: 100-500	40-75% 90% D 10% C	Run/Glide	Reddish/Orange High	Sand (10%) Gravel (10%) Cobble (70%) Boulder (10%) 25-50%	Moss	No erosion evident
04-FDY	Forest Scattered Residential	Trees Shrubs Herbaceous	L: 20-100 R: 0-20	>75% 90% D 10% C	Riffles	Clear High	Sand (40%) Gravel (60%) 25-50%	Moss	L Bank: Heavy erosion R Bank: Moderate erosion
03-FDY	Forest Residential	Trees	L: >500 R: 100-500	>75% 50% D 50% C	Riffles	Clear High	Gravel Some sand 0-25%	Moss	Slight erosion on both banks
01-FDY	Forest Residential	Trees Grasses	L: 0-20 R: 20-100	10-40% 90% D 10% C	Run/Glide	Clear High	Sand (20%) Gravel (40%) Cobble (40%) 25-50%	Moss Plants	Moderate erosion on both banks Invasive knotweed on left bank
04-LIT	Forest (60%) Field/Pasture (10%) Agricultural (10%) Residential (20%)	Trees (80%) Shrubs (10%) Herbaceous (10%)	L: 0-20 R: 20-100	40-75% 70% D 30% C	Riffles	Cloudy High	Cobble 0-25%	Moss	Slight erosion on both banks
15-EXT	Forest (75%) Residential (25%)	Trees Shrubs Herbaceous	L: 20-100 R: 20-100	<10%	Riffles	Clear High	Cobble 50-75%	Moss	L Bank: No erosion evident R Bank: Slight erosion
03-GBR	Forest (50%) Field/Pasture (50%)	Trees	L: 100-500 R: 0-20	>75% 50% D 50% C	Riffles	Reddish/Orange High	Gravel Cobble 25-50%	Moss	Slight erosion on both banks
05-LTE	Forest (90%) Residential (10%)	Trees (60%) Shrubs (20%) Grasses (20%)	L: 20-100 R: 100-500	40-75% 90% D 10% C	Riffles	Clear High	Boulder 50-75%	Moss	Slight erosion on both banks

Note: Data is derived from a standardized Field Volunteer Biomonitoring Habitat Data Sheet included in the Volunteer Biological Assessment Program 2008 Draft Protocol instructions. R = Right bank, L = Left bank, D = Deciduous, C = Coniferous

Appendix G: 2008 Biological Sampling Methods

Background

Macroinvertebrates are organisms capable of being seen by the naked eye such as immature and adult aquatic insects, mollusks, worms, leeches, and crayfish. These organisms have different abilities to tolerate pollution, vary in their habitat preferences, and reflect the shared effects of multiple pollutants and environmental conditions integrated over time. Thus, they are often used as indicators of aquatic community condition.

The New Hampshire Volunteer Biological Assessment Program (VBAP) assists volunteers in the collection and identification of macroinvertebrates throughout NH's streams. Each year, volunteers collect and identify macroinvertebrates and VBAP staff summarizes the data in annual reports for each group. These reports contribute to knowledge about aquatic community conditions and serve as guidance for future monitoring activities. Prior to sampling, VBAP volunteers are trained in sampling techniques, identification, and biotic index computation. Volunteers are also trained to collect and record basic habitat, physical and chemical parameters.

Sampling Station Description

Sampling stations are chosen based on input from VBAP volunteers. All stations must be accessible, wadeable and approximately 50 to 200 feet in length. They must also contain at least one riffle with mixed cobble substrate. Whenever possible, stations must be located upstream of major human influences such as bridges.

Sampling and Data Collection

At each sampling station, volunteers record station information, select the sampling reach, identify five sampling locations within the reach and assess instream and riparian habitat. To avoid disrupting biological communities, volunteers do not walk in the stream and always collect samples from downstream to upstream. At each collection site, volunteers designate a 1/5 m² sampling area and place a 500 micron mesh kicknet immediately downstream of that area. One volunteer holds the net perpendicular to stream flow with the opening of the net facing upstream and the bottom firmly against the substrate (Image 1). A second volunteer agitates the sampling area upstream of the net by using both hands to scrub the rocks within the sample area for 30 seconds and then uses both feet to disturb the sediment within the sample area for 30 seconds.

After agitation, macroinvertebrates should be trapped in the net. The downstream volunteer slowly lifts the net out of the water, being careful not to let any bugs wash downstream. This process is repeated at each sampling location until a total of five samples are collected.

Sorting and Identification

After collection, the entire sample is transferred into a plastic dish pan fitted with 500 micron wire mesh. The sample is mixed for 15 seconds and then divided into four equal portions. One portion is randomly selected for sorting and transferred to a separate tray. The remaining portions are kept in the dish pan and submersed in a plastic basin with water to prevent desiccation. Volunteers sort the selected portion for one hour. During that time, spoons, forceps, or pipettes are used to place specimens into individual containers for identification. If the first portion is completely sorted before one hour had elapsed, an additional portion is selected and sorted. After one hour, specimens are counted and identified to coarse taxonomic groups. Additionally, cumulative sorting effort and estimated total abundance are calculated.

Biotic Index and Accessory Metric Computation

Individual taxonomic groups are each assigned a tolerance value ranging from zero to ten (Table 1). More tolerant groups have a higher tolerance value than less tolerant groups. To compute a taxonomic-specific biotic score VBAP multiplies the number of individuals in a sample by the individual's tolerance value. To compute the final biotic score, VBAP sums the taxonomic-specific biotic scores and then divides by the number of total individuals identified. The Final biotic scores correspond to three categories: excellent (0-3.5), good (3.5-4.8), or fairly poor (>4.8).

Table 1: Order, common name, and tolerance value of aquatic common macroinvertebrates

Order	Common Name	Tolerance Value
Ephemeroptera	Mayfly nymph	3
Plecoptera	Stonefly nymph	1
Trichoptera	Caddisfly larvae	4
Odonata	Dragonfly nymph	3
	Damselfly nymph	7
Diptera	Black fly larvae	7
	Midge larvae	6
	Most true flies	4
Megaloptera	Alderfly	4
	Fishfly or hellgrammite	0
Coleoptera	Riffle beetle	4
	Water penny	4
	Beetle and beetle-like	7
Others	Crayfish	6
	Snails	7
	Aquatic worms	8
	Scuds	8
	Sowbugs	7
	Clams and mussels	8

Abundance, which estimates the total number of organisms within the sample, is calculated by multiplying the number of individuals sorted by the fraction of the sample sorted. The percentage of EPT (Ephemeroptera, Plecoptera, and Trichoptera) individuals within the sample is also calculated to provide an estimate of the amount of least tolerant taxa present at each site.

Water Chemistry

In addition to biological sampling, basic water quality data including pH, dissolved oxygen, specific conductance, and temperature are collected whenever possible using VRAP Standard Operating Procedures (SOPs) and handheld meters provided by NHDES.

Quality Control Test

Quality control samples were not collected in the 2008 season.