New Hampshire Volunteer River Assessment Program
2008 Cains Brook Watershed Water Quality Report

February 2009

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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State of New Hampshire
Department of Environmental Services
Water Division
Watershed Management Bureau
P.O. Box 95
29 Hazen Drive
Concord, New Hampshire 03302-0095
www.des.nh.gov

Thomas S. Burack
Commissioner

Harry T. Stewart
Water Division Director

Prepared By:

Ted Walsh, VRAP Program Manager

Jen Drociak, VRAP Coordinator

Danielle Mucciarone, VRAP Assistant

Catherine Foley, Coastal VBAP Coordinator

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Cover Photo: Cains Brook, 04-CNS, Seabrook

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ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Cains Brook VRAP Group and the Seabrook Conservation Commission for their efforts during 2008. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

2008 Cains Brook Volunteers

Sue Foote

Dick Dodge

Patty Evans

Lisa Loosigian

Duncan Mellor

Teagen Mellor

Jack Mettee

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 is 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 Program. 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. Beginning 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/.

2.7 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.

2.7.1 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 2007, volunteers from the Cains Brook VRAP Group and the Seabrook Conservation Commission began water quality monitoring in the Cains Brook watershed. The goal of this effort was to provide water quality data from the Cains Brook watershed relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contract recreation (swimming). 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. The Volunteer River Assessment Program has provided field training, equipment, technical assistance, and financial assistance for laboratory costs.

In addition, funded through a grant from the New Hampshire Estuaries Project (NHEP), a Cains Brook and Mill Creek Watershed Management Plan was created in December of 2006. The purpose of the watershed management plan recommends additional activities that will provide the opportunities to restore the aquatic and riverine resources to the watershed, as well as provide recreational opportunities for small boat access, fishing, walking and bird watching.

During 2008, trained volunteers from the Cains Brook VRAP group monitored water quality at eight stations in the Cains Brook 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. The entire Cains Brook watershed is designated as Class B waters. This class is used to apply the appropriate water quality standard.

Water quality monitoring was conducted monthly from May to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters provided by NHDES. Samples for *E.coli* and chloride were taken using bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the lab. Table 3 summarizes the parameters measured, laboratory standard methods, and equipment used.

In 2008, volunteers also conducted a biological assessment in the Cains Brook watershed. The goal of this effort is to complete "screening" level investigations of aquatic macroinvertebrate communities inhabiting Cains Brook. 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.

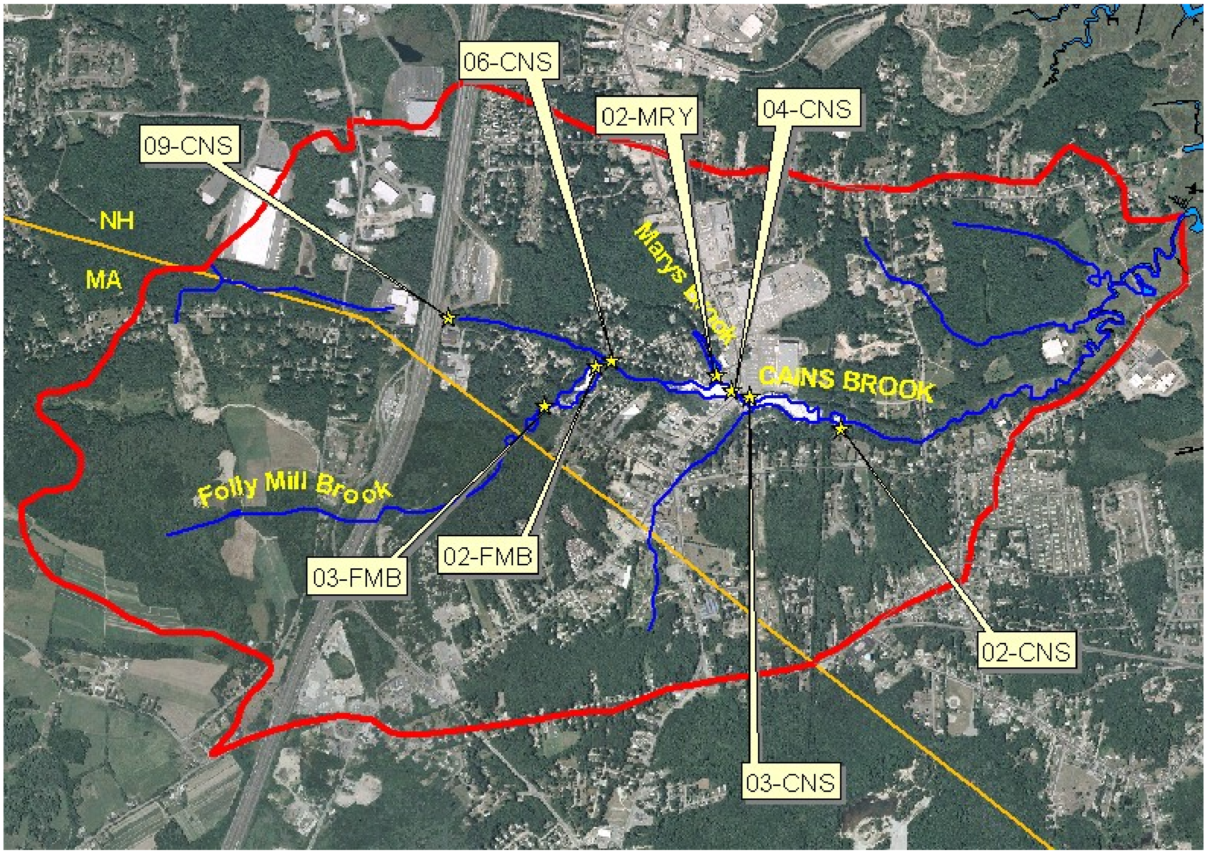
Table 2. Sampling Stations for the Cains Brook Watershed, NHDES VRAP, 2008

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation *(Rounded to the Nearest 100 Feet)*
09-CNS NHRIV801070201-06	**B**	**Cains Brook**	Cains Brook Downstream of I-95	Seabrook	0
03-FMB NHRIV600031004-09	**B**	**Folly Mill Brook**	Upstream of Folly Mill Road	Seabrook	0
02-FMB NHIMP600031004-04	**B**	**Folly Mill Brook**	Secords Pond Outlet	Seabrook	0
06-CNS NHRIV600031004-10	**B**	**Cains Brook**	Downstream of Secords Pond	Seabrook	0
02-MRY NHIMP600031004-07	**B**	**Marys Brook**	Marys Pond Above Dam	Seabrook	0
04-CNS NHIMP600031004-05	**B**	**Cains Brook**	Cains Pond Outlet at Weir	Seabrook	0
03-CNS NHRIV600031004-11	**B**	**Cains Brook**	Cains Mill Pond Inlet, Seabrook	Seabrook	0
02-CNS NHIMP600031004-06	**B**	**Cains Brook**	Noyes Pond Outlet	Seabrook	0

Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 85	------
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 85	------
pH	In-Situ	SM 4500 H+	Oakton pH 11	------
Turbidity	In-Situ	EPA 180.1	LaMotte 2020 e	------
Specific Conductance	In-Situ	SM 2510	YSI 85	------
E.coli	Bottle (Sterile)	SM 19 9213 D.3	------	NHDES
Chloride	Bottle	EPA 325.2	------	NHDES

Figure 1. Cains Brook Watershed and Monitoring Stations 2008



4.0 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

Five measurements were taken in the field for dissolved oxygen concentration at eight stations in the Cains Brook watershed in Seabrook (Table 4). Of the 40 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.

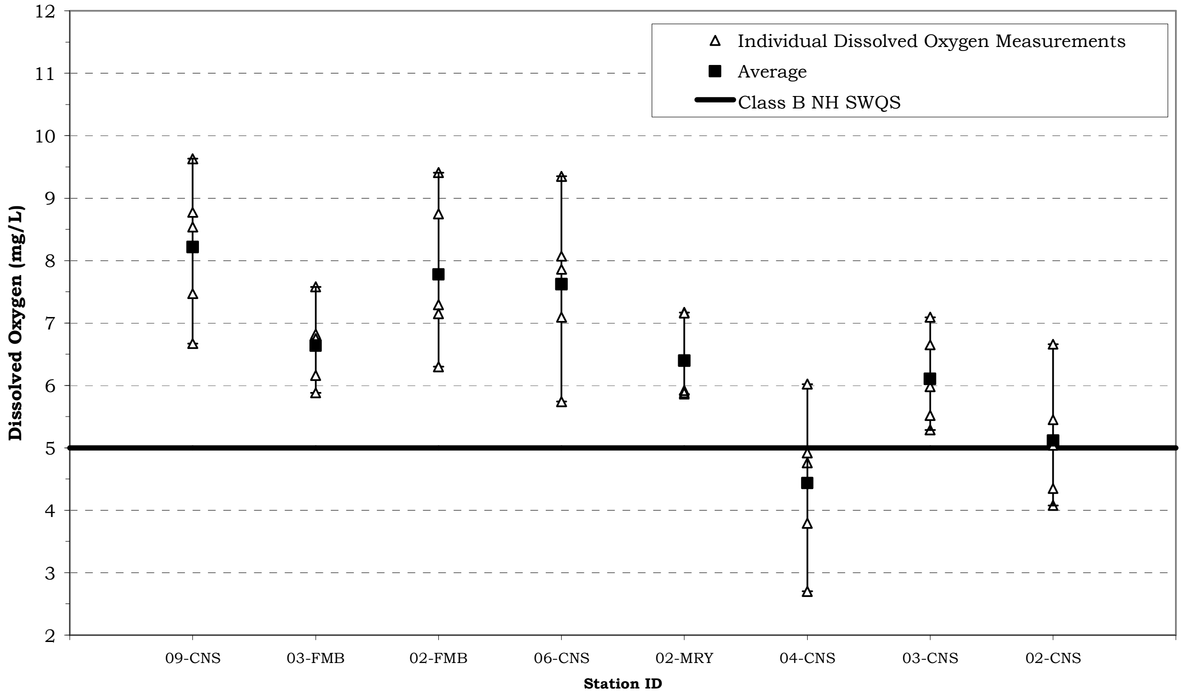
Table 4. Dissolved Oxygen (mg/L) Summary – Cains Brook Watershed, 2008

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
09-CNS	5	6.67 - 9.63	0	5
03-FMB	5	5.88 - 7.58	0	5
02-FMB	5	6.30 - 9.41	0	5
06-CNS	5	5.74 - 9.35	0	5
02-MRY	5	5.86 - 7.17	0	5
04-CNS	5	2.70 - 6.02	4	5
03-CNS	5	5.29 - 7.09	0	5
02-CNS	5	4.08 - 6.66	2	5
Total	**40**	_____	**6**	**40**

Dissolved oxygen concentration levels met New Hampshire Class B surface water quality standards at six stations on all occasions (Figure 2). Four measurements taken at station 04-CNS, and two measurements taken at station 02-CNS were below the standard. The average dissolved oxygen concentration levels ranged from 5.12 mg/L to 8.22 mg/L. 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 Cains Brook Watershed May 28 - September 24, 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.

- Consider incorporating the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. Deployment of dataloggers for dissovled oxygen should be targeted at those stations suspected of not meeting surface water quality standards.

4.2 pH

Either four or five measurements were taken in the field for pH at eight stations in the Cains Brook watershed in Seabrook (Table 5). Of the 36 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.

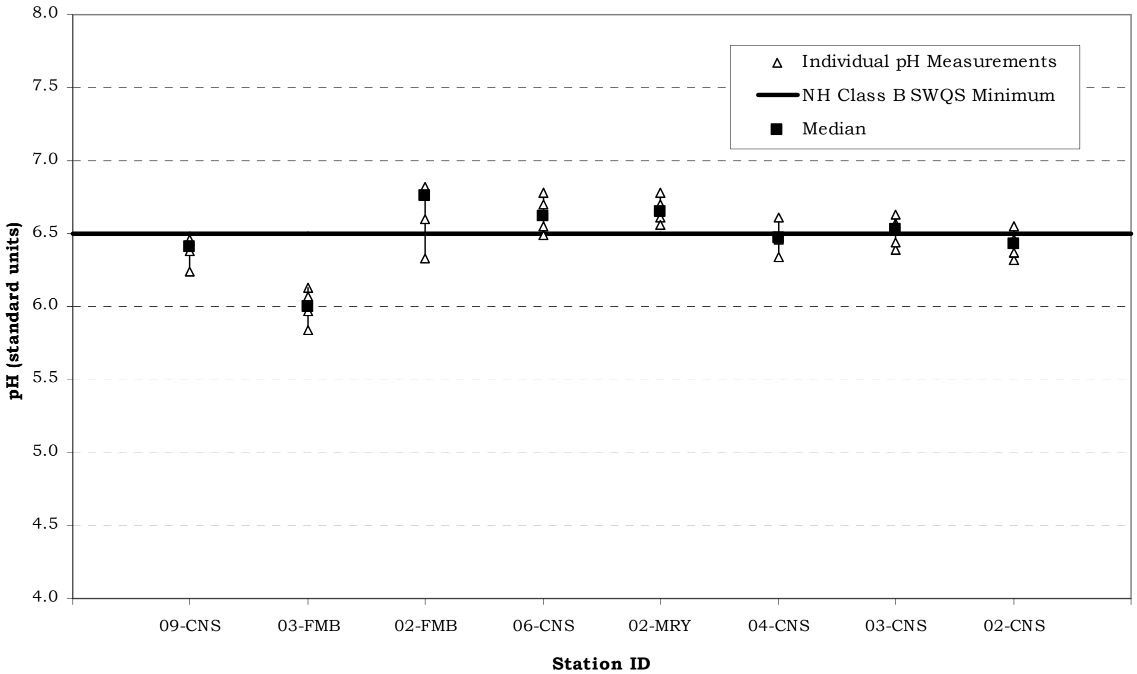
Table 5. pH Data Summary - Cains Brook Watershed, 2008

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
09-CNS	4	6.24 - 6.46	4	4
03-FMB	5	5.84 - 6.13	5	5
02-FMB	5	6.33 - 6.82	1	5
06-CNS	4	6.49 - 6.78	1	4
02-MRY	4	6.56 - 6.78	0	4
04-CNS	4	6.34 - 6.61	3	4
03-CNS	5	6.39 - 6.63	2	5
02-CNS	5	6.32 - 6.55	4	5
Total	**36**	_____	**20**	**36**

All but one station (02-MRY) had one or more pH measurements that were below the minimum New Hampshire surface water quality standard (Figure 3).

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 Cains Brook Watershed
May 28 - September 24, 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

Either four or five measurements were taken in the field for turbidity at eight stations in the Cains Brook watershed in Seabrook [Table 6]. Of the 34 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.

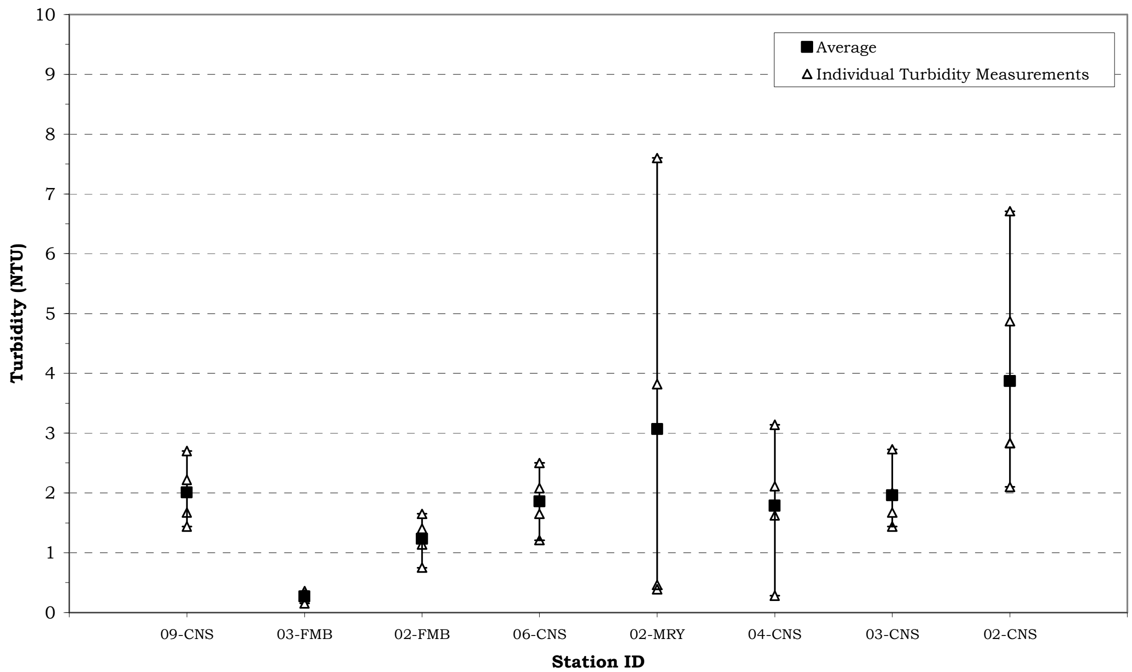
The Class B New Hampshire surface water quality standard for turbidity is less than 10 NTU above natural background.

Table 6. Turbidity Data Summary - Cains Brook 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
09-CNS	4	1.44 - 2.70	0	4
03-FMB	4	0.15 - 0.36	0	4
02-FMB	4	0.75 - 1.65	0	4
06-CNS	4	1.21 - 2.50	0	4
02-MRY	4	0.39 - 7.60	0	4
04-CNS	4	0.28 - 3.14	0	4
03-CNS	5	1.44 - 2.73	0	5
02-CNS	5	2.10 - 6.71	0	5
Total	**34**	_____	**0**	**34**

Turbidity levels were low throughout the entire watershed with the average ranging from 0.27 NTU to 3.87 NTU (Figure 4). Slightly higher turbidity measurements were generally found in the lower portions of 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 Cains Brook Watershed
May 28 - September 24, 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

Five measurements were taken in the field for specific conductance at eight stations in the Cains Brook watershed in Seabrook (Table 7). Of the 40 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.

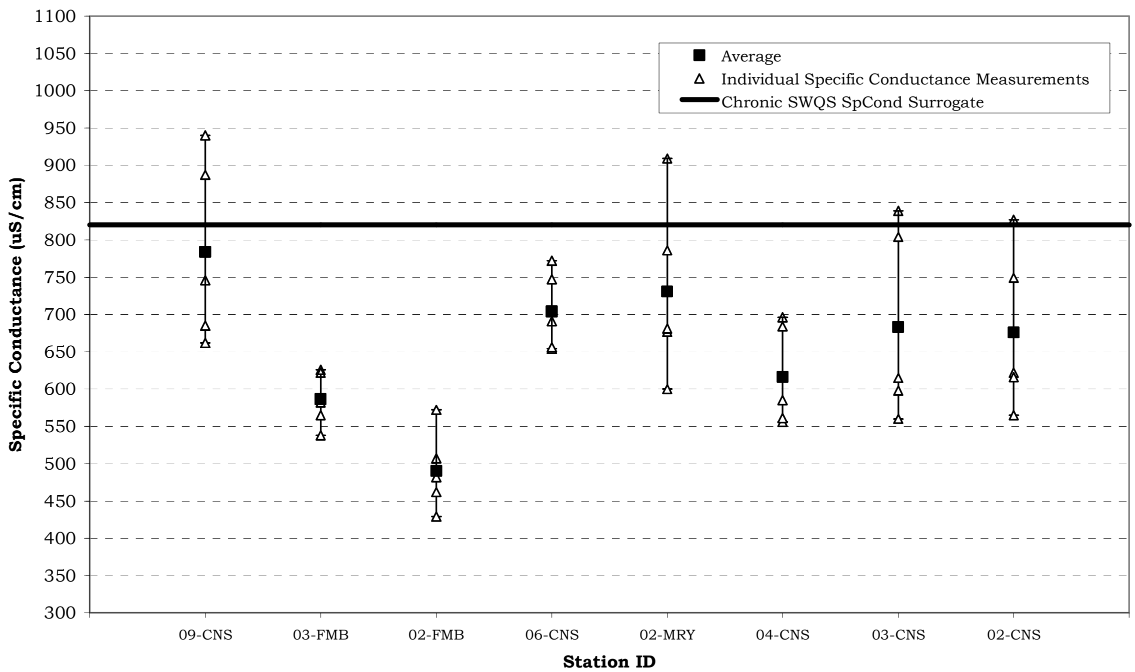
New Hampshire surface water quality standards do not contain numeric criteria for specific conductance although in many fresh surface waters, specific conductance can be used as a surrogate to predict compliance with numeric water quality criteria for chloride.

Table 7. Specific Conductance Data Summary - Cains Brook 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
09-CNS	5	662 - 940	2	5
03-FMB	5	538 - 626	0	5
02-FMB	5	429 - 572	0	5
06-CNS	5	654 - 772	0	5
02-MRY	5	600 - 909	1	5
04-CNS	5	556 - 696	0	5
03-CNS	5	560 - 839	1	5
02-CNS	5	565 - 827	1	5
Total	**40**	_____	**5**	**40**

Specific conductance measurements were variable and high throughout the entire watershed with the average ranging from 490 µS/cm to 784 µS/cm (Figure 5). Four stations had one or more specific conductance measurements that correlate to a chloride measurement in exceedence of the state of New Hampshire freshwater chronic criterion for chloride of 230 mg/L. Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. Thus, the higher specific conductance levels generally indicate higher pollutant levels.

Figure 5. Specific Conductance Statistics for the Cains Brook Watershed
May 28 - September 24, 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

Five measurements were taken in the field for water temperature at eight stations in the Cains Brook watershed in Seabrook (Table 8). Of the 40 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 – Cains Brook Watershed, 2008

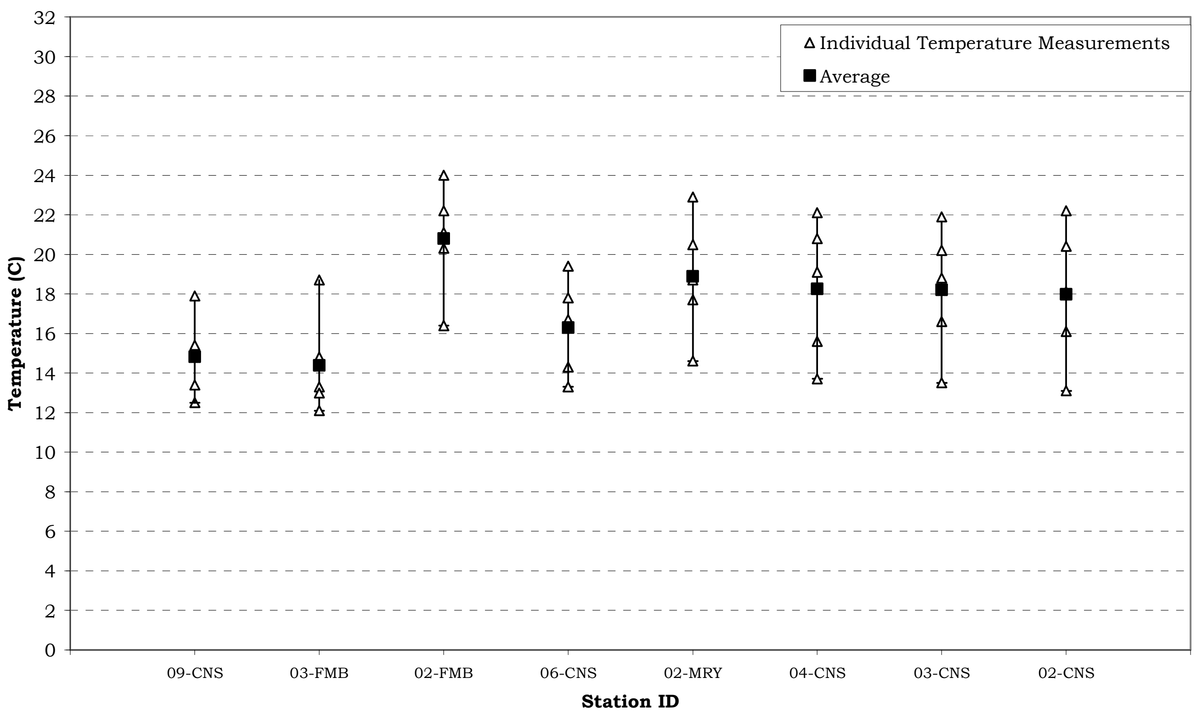
Station ID	Samples Collected	Data Range (°C)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
09-CNS	5	12.5 - 17.9	Not Applicable	5
03-FMB	5	12.1 - 18.7	N/A	5
02-FMB	5	16.4 – 24.0	N/A	5
06-CNS	5	13.3 - 19.4	N/A	5
02-MRY	5	14.6 - 22.9	N/A	5
04-CNS	5	13.7 - 22.1	N/A	5
03-CNS	5	13.5 - 21.9	N/A	5
02-CNS	5	13.1 - 22.2	N/A	5
Total	**40**	_____	**N/A**	**40**

Figure 6 shows the results of instantaneous water temperature measurements taken at eight stations in the Cains Brook watershed. The average water temperature varied from 17.9 °C. to 22.9 °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 macroinvertabrate 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 Cains Brook Watershed
May 28 - September 24, 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 *Escherichia coli*/Bacteria

Four samples were taken for *Escherichia coli* (*E. coli*) at eight stations in the Cains Brook watershed in Seabrook (Table 9). Of the 32 samples 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.

Class B New Hampshire surface water quality standards for *E.coli* are as follows:

$\leq$406 cts/100 ml, based on any single sample or
$\leq$126 cts/100 ml, based on a geometric mean calculated from three samples collected within a 60-day period.

Table 9. *E.coli* Data Summary – Cains Brook Watershed, 2008

Station ID	Samples Collected	Data Range (cts/100ml)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
09-CNS	4	130 - 460	1	4
03-FMB	4	30 - 40	0	4
02-FMB	4	5 - 33.75	0	4
06-CNS	4	180 - 252.5	0	4
02-MRY	4	40 - 167.5	1	4
04-CNS	4	5 - 51.25	0	4
03-CNS	4	30 - 67.5	0	4
02-CNS	4	20 - 140	0	4
Total	**32**	_____	**2**	**32**

All but two measurements met the New Hampshire Class B single sample water quality standard for *E.coli* (Figure 7). In order to fully determine whether a waterbody is meeting surface water standards for *E.coli* a geometric mean must be calculated. A geometric mean is calculated using three samples collected within a 60-day period. At all stations one geometric mean was calculated. Of the eight geometric means calculated all but two geometric means (stations 09-CNS and 06-CNS) met the state of New Hampshire Class B geometric mean standard of 126 cts/100ml (Table 10).

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

Figure 7. *Escherichia coli* Statistics for the Cains Brook Watershed
June 25 -September 24, 2008 NHDES VRAP

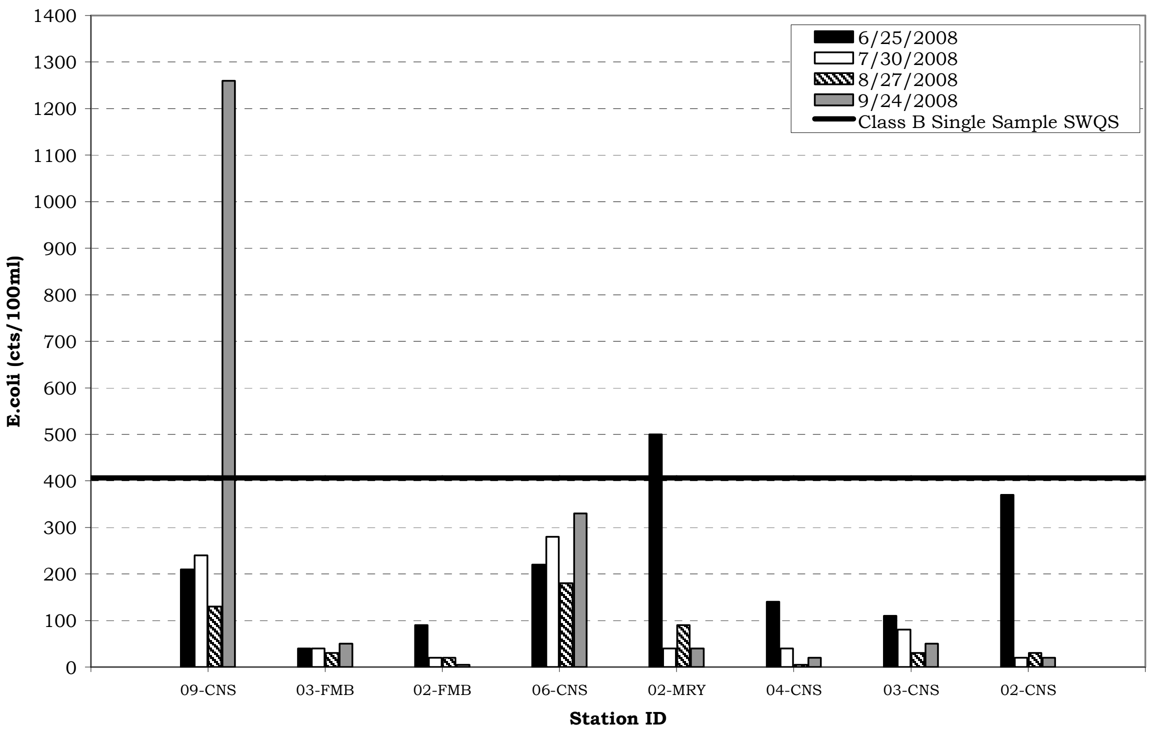


Table 10. *E. coli* Geometric Mean Data Summary – Cains Brook Watershed, 2008

Station ID	Geometric Means Calculated	Geometric Mean July 30, 2008 - September 24, 2008	Geometric Means Not Meeting NH Class B Standards	Number of Usable Geometric Means for 2010 NH Surface Water Quality Assessment
09-CNS	1	340	1	1
03-FMB	1	39	0	1
02-FMB	1	13	0	1
06-CNS	1	255	1	1
02-MRY	1	52	0	1
04-CNS	1	16	0	1
03-CNS	1	49	0	1
02-CNS	1	23	0	1
Total	**8**	_____	**2**	**8**

Recommendations

- Continue collecting three samples within any 60-day period during the summer to allow for determination of geometric means. Samples need only be collected during the critical period of May 24 to September 15 for assessment purposes. This coincides with the peak contact recreation season.
- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).

4.7 Chloride

One sample was taken for chloride at eight stations in the Cains Brook watershed in Seabrook [Table 11]. Of the eight 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 chloride is as follows:

Freshwater chronic criterion	230 mg/l
Freshwater acute criterion	860 mg/l

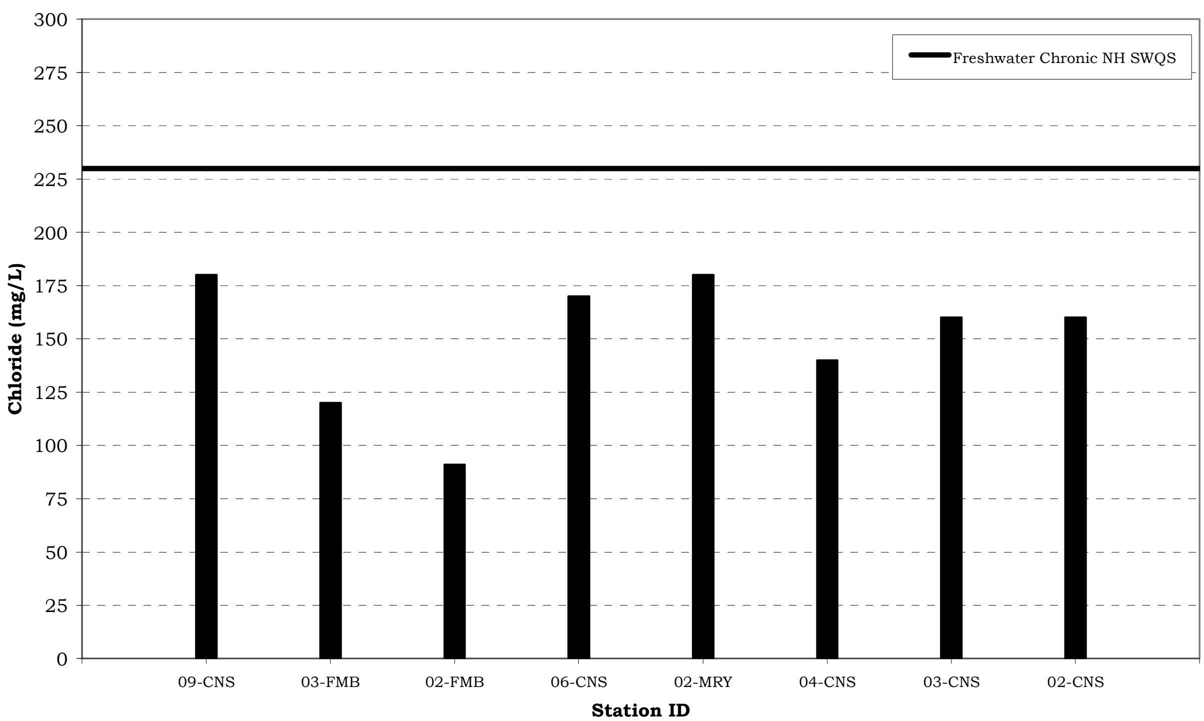
Table 11. Chloride Data Summary – Cains Brook Watershed, 2008

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
09-CNS	1	180	0	1
03-FMB	1	120	0	1
02-FMB	1	91	0	1
06-CNS	1	170	0	1
02-MRY	1	180	0	1
04-CNS	1	140	0	1
03-CNS	1	160	0	1
02-CNS	1	160	0	1
Total	**8**	____	**0**	**8**

All measurements were below the state of New Hampshire Class B chronic surface water quality standard of 230 mg/L (Figure 8). In general, chloride measurements were highest at stations 09-CNS and 02-MRY, and lowest at station 02-FMB.

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. Road salt readily dissolves and enters aquatic environments in ionic forms. 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). 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. Additional human sources of chloride can come from fertilizers, septic systems, and underground water softening systems.

Figure 8. Chloride Statistics for the Cains Brook Watershed
July 30, 2008 NHDES VRAP



Recommendations

- Continue collecting chloride samples during both low-flow summer months and during snowmelt period in winter and early spring. It is critical that specific conductance be recorded when chloride samples are collected.

4.8 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 the Cains Brook sampling station was comprised of industrial land and bordered the I-95 corridor. The total width of the riparian zone was estimated to be less than 20 feet on both the left and right bank. The canopy cover over the stream was greater than 75 percent. Deciduous trees comprised a majority (95%) of vegetative canopy composition.

In-stream Habitat

Water was described as reddish/orange and flows were near the seasonal average. Woody debris was present and frequently encountered. The stream substrate was comprised primarily of gravel and cobble. Sand and silt were also observed. The substrate was estimated to be between 25 and 50 percent embedded. Only slight erosion was noticeable on the left bank and moderate erosion, which was beginning to affect the streambed, was reported on the right bank.

Biological Community Condition

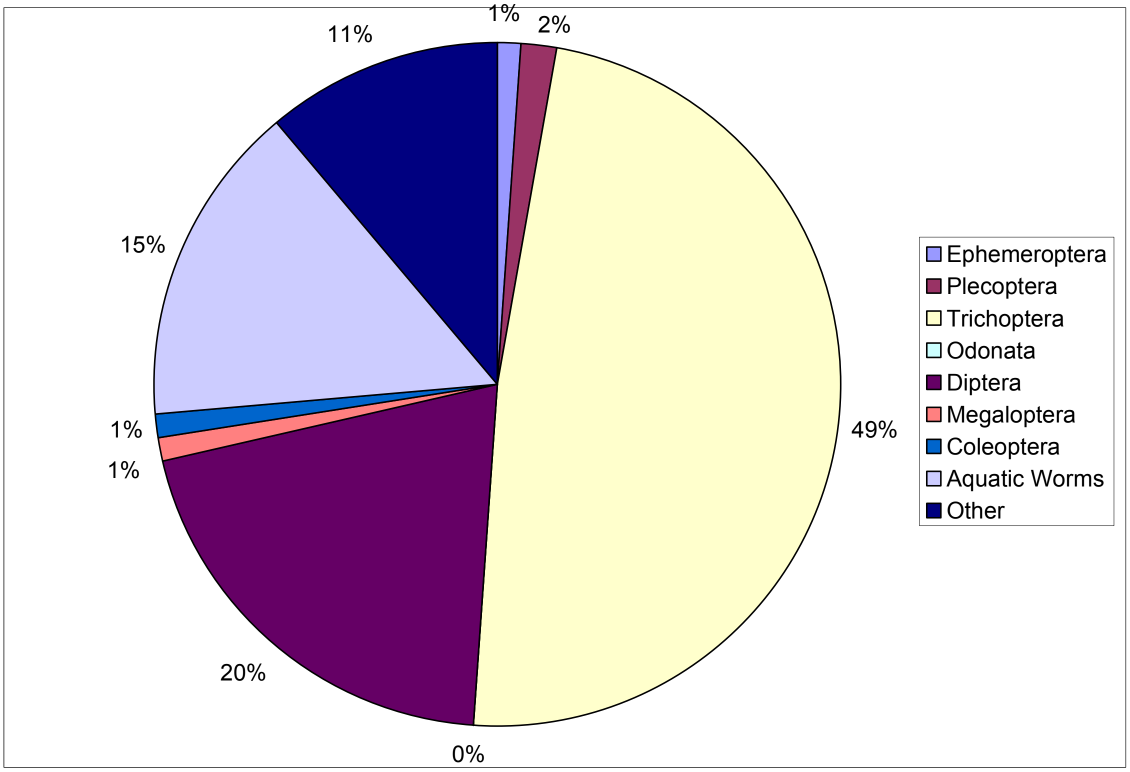
The biotic score was 5.34, corresponding to the “fairly poor” category (Table 12). The percentage of EPT individuals refers to the total percentage of Ephemeroptera (mayfly nymphs), Plecoptera (stonefly nymphs), and Trichoptera (caddisfly larvae) individuals in a sample. Generally, the percent of EPT individuals increases with increasing water quality. The percentage of EPT individuals in Cains Brook was 51.12 percent.

Table 12. Biological Data Summary – Cains Brook, 2008.

Station ID	Biotic Score	Narrative Category	EPT (%)
09-CNS	5.34	Fairly Poor	51.12%

A total of 178 macroinvertebrates from 12 taxonomic groups were collected and identified in Cains Brook. The estimated macroinvertebrate abundance was 356 individuals per sample. The most abundant taxonomic group in the watershed were the Trichoptorans (caddisfly larvae), comprising 49 percent of the total sample. Diptera (true flies) and aquatic worms were also well represented in the total sample, accounting for 20 and 15 percent of the total sample, respectively.

Figure 9. Biological Sample Composition Statistics - Cains Brook, 2008.



Quality Control Test

No quality control sample was taken in the Cains Brook watershed.

Recommendations

- Investigate potential impacts from I-95 and consider closely monitoring water quality at 09-CNS through further physical, chemical, and biological sampling to determine the potential causes of the "fairly poor" results.

- Continue annual sampling at this station in order to develop a long term data set to better understand trends as time goes on.

APPENDIX A: 2008 CAINS BROOK WATERSHED VRAP DATA

(blue shading) Measurements not meeting New Hampshire surface water quality standards
(diagonal line) Measurements not meeting NHDES quality assurance/quality control standards

[A] Chronic Water Quality Standard

09-CNS, Cain's Brook Downstream of I95, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	<406	<126	230A
05/28/2008	12:10	9.63	96.4		1.67	746	12.5			
06/25/2008	11:00	8.54	87.5	6.24	1.44	662	15.4	210		
07/30/2008	10:55	7.47	78.6	6.38	2.70	685	17.9	240		180
08/27/2008	11:09	8.77	86.7	6.45	2.22	940	14.9	130		
09/24/2008	11:30	6.67	63.9	6.46		887	13.4	1260	340	

03-FMB, Folly Mill Brook Upstream of Folly Mill Road, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	<406	<126	230A
05/28/2008	11:35	7.58	68.4	6.13	0.36	622	18.7			
06/25/2008	11:30	6.82	65.6	5.84	0.15	626	13.3	40		
07/30/2008	11:08	6.16	60.9	6.07	0.26	538	14.8	40		120
08/27/2008	10:32	6.75	64.2	5.97	0.30	582	13.0	30		
09/24/2008	10:45	5.88	54.9	6.00		565	12.1	50	39	

02-FMB, Secord's Pond Outlet, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	<406	<126	230[A]
05/28/2008	11:50	9.41	102.5	6.76	1.14	507	20.3			
06/25/2008	11:35	8.75	102.0	6.78	1.65	572	22.2	90		
07/30/2008	10:27	7.29	88.8	6.60	1.40	429	24.0	20		91
08/27/2008	10:46	7.15	80.9	6.82	0.75	482	21.1	20		
09/24/2008	11:13	6.30	65.1	6.33		462	16.4	5	13	

06-CNS, Cain's Brook Downstream of Secord's Pond, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	As Naturally Occuring	(µS/cm as chloride surrogate)	Narrative	<406	<126	230A
05/28/2008	11:57	9.35	92.9		1.21	691	14.3			
06/25/2008	11:50	5.74	62.2	6.55	1.65	654	17.8	220		
07/30/2008	10:40	7.09	76.8	6.49	2.50	656	19.4	280		170
08/27/2008	10:40	7.86	81.1	6.78	2.08	772	16.7	180		
09/24/2008	11:05	8.07	81.3	6.70		747	13.3	330	255	

02-MRY, Mary's Pond Above Dam, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	As Naturally Occuring	(µS/cm as chloride surrogate)	Narrative	<406	<126	230A
05/28/2008	11:10	5.88	60.2		0.39	909	17.7			
06/25/2008	10:25	7.17	79.4	6.61	3.82	677	20.5	500		
07/30/2008	10:12	5.86	68.4	6.56	7.60	681	22.9	40		180
08/27/2008	10:09	5.92	63.2	6.78	0.46	786	18.7	90		
09/24/2008	10:21	7.16	70.7	6.70		600	14.6	40	52	

04-CNS, Cain's Pond Outlet at Weir, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5 - 8.0	As Naturally Occuring	(µS/cm as chloride surrogate)	Narrative	<406	<126	230A
05/28/2008	10:55	4.76	51.2		1.62	696	15.6			
06/25/2008	10:30	6.02	66.6	6.48	3.14	556	20.8	140		
07/30/2008	10:07	2.70	30.9	6.34	2.11	561	22.1	40		140
08/27/2008	10:05	3.79	40.8	6.61	0.28	684	19.1	5		
09/24/2008	10:15	4.92	47.6	6.46		585	13.7	20	16	

03-CNS, Cain's Mill Pond Inlet, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5 - 8.0**	**As Naturally Occuring**	**(µS/cm as chloride surrogate)**	**Narrative**	**<406**	**<126**	**230A**
05/28/2008	10:30	5.29	55.4	6.57	1.44	839	16.6			
06/25/2008	10:20	6.65	73.1	6.39	2.73	560	20.2	110		
07/30/2008	10:00	5.52	63.0	6.44	2.00	615	21.9	80		160
08/27/2008	09:51	5.98	64.2	6.63	1.67	804	18.8	30		
09/24/2008	09:55	7.09	68.3	6.53	1.97	598	13.5	50	49	

02-CNS, Noyes Pond Outlet, Seabrook

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	*E.coli* Geometric Mean	Chloride (mg/L)
Standard	**NA**	**>5.0**	**>75% Daily Average**	**6.5 - 8.0**	**As Naturally Occuring**	**(µS/cm as chloride surrogate)**	**Narrative**	**<406**	**<126**	**230A**
05/28/2008	09:25	4.08	42.3	6.43	2.83	827	16.1			
06/25/2008	09:35	5.45	60.1	6.32	6.71	565	20.4	370		
07/30/2008	09:30	4.35	50.1	6.37	2.10	622	22.2	20		160
08/27/2008	09:20	5.04	57.0	6.46	2.83	749	18.1	30		
09/24/2008	09:21	6.66	63.6	6.55	4.87	616	13.1	20	23	

APPENDIX B:
Interpreting VRAP Water Quality Monitoring Parameters

Chemical Parameters

<u>Dissolved Oxygen</u> (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.

<u>pH</u>

- **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 µS/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 at 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 bv 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 macroinvertabrate 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 30, 2008 VRAP staff visited volunteers from the Cain's Brook 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 Cain's Brook 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.

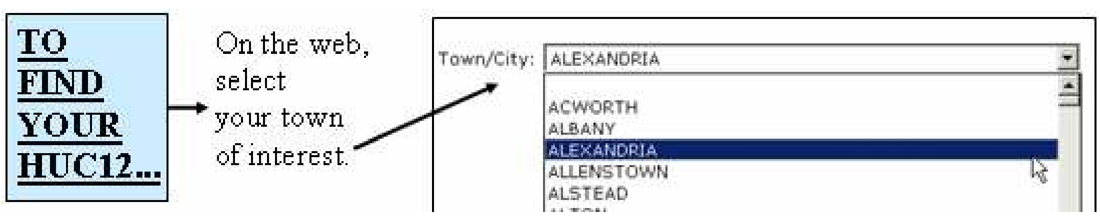
Each Watershed Report Card covers a single 12 digit Hydrologic Unit Code (HUC12), on average a 34 square mile area. Each Watershed Report Card has three components;

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



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 010600031004

HUC 12 NAME HAMPTON HARBOR

(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.
NHEST600031004-01-02	E*01-02	HAMPTON FALLS RIVER (WWTF SZ)	3-PAS	3-PNS	2-G	5-M
NHEST600031004-01-03	E*01-03	HAMPTON FALLS RIVER	3-PAS	3-ND	3-ND	5-M
NHEST600031004-02-02	E*02-02	TAYLOR RIVER (LOWER)	3-PAS	2-G	2-G	5-M
NHEST600031004-02-03	E*02-03	BLIND CREEK WWTF SZ	3-ND	3-ND	3-ND	5-M
NHEST600031004-02-05	E*02-05	NUDDS CANAL	3-PAS	3-ND	3-ND	5-M
NHEST600031004-03-03	E*03-03	TIDE MILL CREEK	3-PAS	3-PAS	3-PAS	5-M
NHEST600031004-04-01	E*04-01	HAMPTON RIVER WWTF SZ	3-PAS	3-PAS	3-ND	5-M
NHEST600031004-05-01	E*05-01	BROWNS RIVER (LOWER)	3-ND	3-ND	3-ND	5-M
NHEST600031004-05-02	E*05-02	BACK CREEK	3-ND	3-ND	3-ND	5-M
NHEST600031004-05-03	E*05-03	SWAINS CREEK	3-ND	3-ND	3-ND	5-M
NHEST600031004-05-04	E*05-04	BROWNS RIVER (UPPER)	3-ND	3-ND	3-ND	5-M
NHEST600031004-06-01	E*06-01	HUNTS ISLAND CREEK (LOWER)	3-ND	3-ND	3-ND	5-M
NHEST600031004-06-02	E*06-02	HUNTS ISLAND CREEK (UPPER)	3-ND	3-ND	3-ND	5-M
NHEST600031004-07	E*07	MILL CREEK	3-PAS	3-PAS	3-PAS	5-M
NHEST600031004-08-04	E*08-04	BLACKWATER RIVER	3-PAS	3-PAS	2-G	5-M
NHEST600031004-08-05	E*08-05	BLOOD CREEK	3-ND	3-ND	3-ND	5-M
NHEST600031004-09-05	E*09-05	HAMPTON/SEABROOK HARBOR - SEABROOK HARBOR BEACH	3-PAS	5-P	2-M	5-M
NHEST600031004-09-06	E*09-06	HAMPTON/SEABROOK HARBOR - HAMPTON HARBOR BEACH	3-PAS	2-G	2-G	5-M
NHEST600031004-09-07	E*09-07	FISH COOP 150' SZ	3-PAS	3-ND	3-ND	5-M
NHEST600031004-09-08	E*09-08	HAMPTON RIVER MARINA SZ	3-PAS	5-P	5-P	5-M
NHEST600031004-09-09	E*09-09	HAMPTON/SEABROOK HARBOR	3-PAS	2-G	2-G	5-M
NHIMP600031004-01	I*01	UNKNOWN RIVER - MILL POND DAM	3-ND	3-ND	3-ND	4A-M
NHIMP600031004-02	I*02	LITTLE RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600031004-03	I*03	UNKNOWN RIVER	3-ND	3-ND	3-ND	4A-M
NHIMP600031004-04	I*04	UNKNOWN RIVER - SECOND POND DAM	3-PNS	2-G	2-G	4A-M
NHIMP600031004-05	I*05	CAINS BROOK	5-P	2-G	5-M	4A-M
NHIMP600031004-06	I*06	UNKNOWN RIVER - CAINS MILL POND	3-PAS	2-M	2-G	4A-M
NHIMP600031004-07	I*07	MARY'S BROOK - MARY'S POND DAM	3-PNS	2-G	2-G	4A-M
NHLAK600031004-01	L*01	MEADOW POND	3-ND	3-ND	3-ND	4A-M

WATERSHED 305(b) ASSESSMENT SUMMARY REPORT:

HUC 12 010600031004

HUC 12 NAME HAMPTON HARBOR

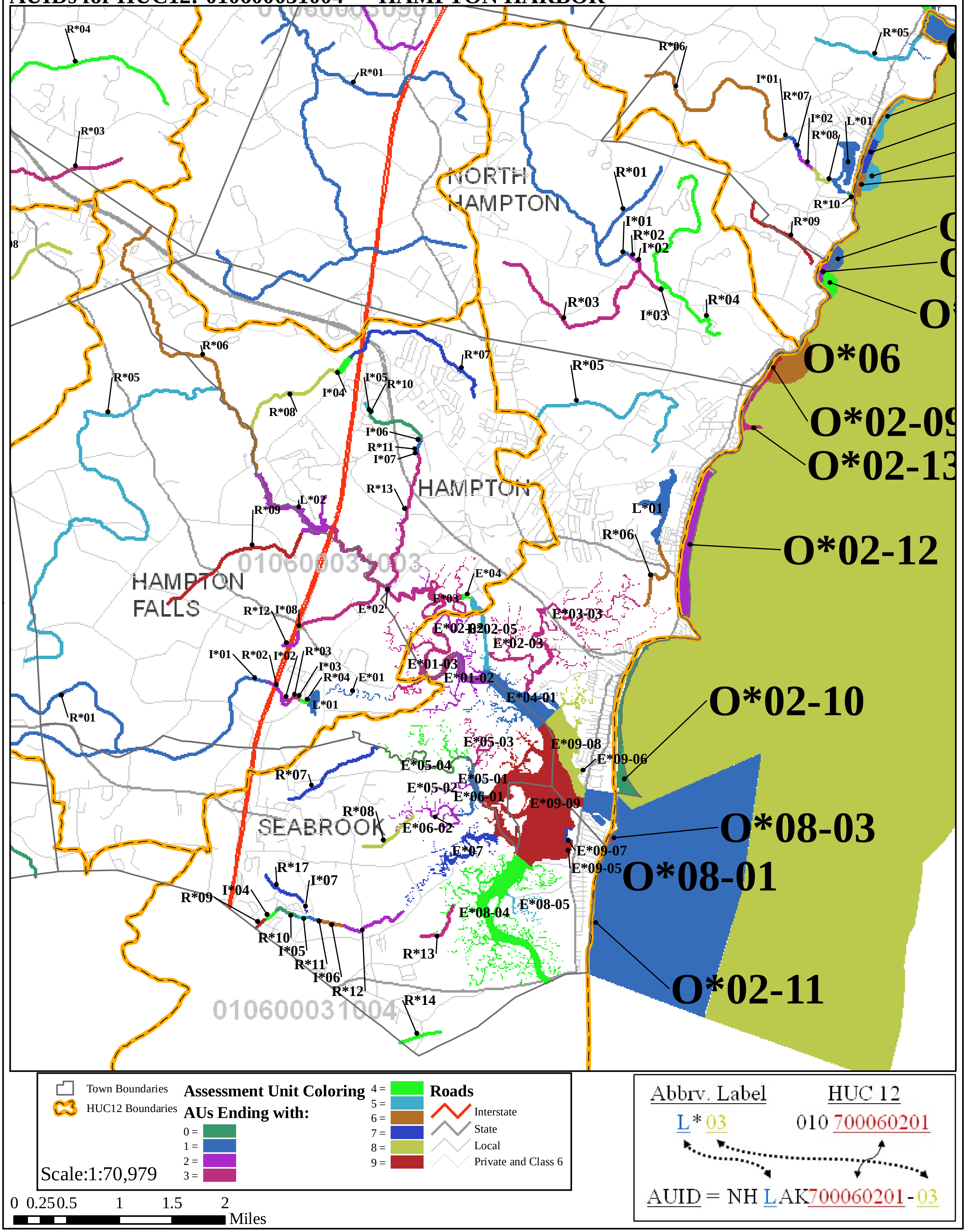
(Locator map on next page only applies to this HUC12)

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.
NHRIV600031004-04	R*04	LITTLE RIVER	5-P	2-M	2-G	4A-M
NHRIV600031004-05	R*05	NILUS BROOK - THRU LAMPREY POND	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-06	R*06	TIDE MILL CREEK	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-07	R*07	BROWNS RIVER	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-08	R*08	FARM BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-09	R*09	UNNAMED BROOK - TO CAINES BROOK	5-M	2-M	2-G	4A-M
NHRIV600031004-10	R*10	CAIN'S BROOK	3-PNS	5-P	5-M	4A-M
NHRIV600031004-11	R*11	CAIN'S BROOK	3-PNS	2-M	2-G	4A-M
NHRIV600031004-12	R*12	CAIN'S BROOK	3-ND	5-P	5-M	4A-M
NHRIV600031004-13	R*13	UNNAMED BROOK - TO MORRILS CREEK	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-14	R*14	CAIN'S BROOK	3-ND	3-ND	3-ND	4A-M
NHRIV600031004-17	R*17	MARY'S BROOK	3-ND	3-ND	3-ND	4A-M

AUIDs for HUC12: 010600031004 - HAMPTON HARBOR



Appendix E:
2008 Cains Brook Biological Data

Order	Common Name	Tolerance Value	09-CNS
Ephemeroptera	Mayfly Nymph	3	2
Plecoptera	Stonefly Nymph	1	3
Trichoptera	Caddisfly Larvae	4	86
Odonata	Dragonfly Nymph	7	0
	Damselfly Nymph	3	0
Diptera	Black Fly Larvae	7	6
	Midge Larvae	6	25
	Most True Flies	4	5
Megaloptera	Alderfly	4	2
	Fishfly Larvae or Hellgrammite	0	0
Coleoptera	Beetle & Beetle-like	7	1
	Riffle Beetle	4	1
	Water Penny	4	0
Other	Aquatic Worms	8	27
	Clams & Mussels	7	0
	Crayfish	7	0
	Scuds	8	11
	Snails	7	0
	Sowbug	7	9
Total Number of Macroinvertebrates			**178**
Biotic Score			**5.34**
EPT (%)			**51.12%**
Estimated Abundance			**356**

Appendix F:
2008 Cains Brook 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 (%)	Water Color & Stream Flow	Substrate & Embeddness (%)	Aquatic Vegetation	
09-CNS	Industrial/ Other (Route I-95)	Trees Shrubs Herbaceous	R: 0-20 L: 0-20	>75% 95% D 5% C	Reddish/Orange Moderate	20% Silt 20% Sand 40% Gravel 20% Cobble 25-50% Embedded	Moss	Right Bank: Moderate Left Bank = Slight - Invasive species along banks: Japanese Knotweed & Virginia Creeper - Siltation in stream appears to be new – it did not exist 3 weeks prior to sampling - Iron bacteria coming from a seep and I-95 culvert

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 m^2 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.