New Hampshire Volunteer River Assessment Program
2009 Cold River Watershed Water Quality Report

January 2010

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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.

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 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.

2.5 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.

VRAP groups conduct sampling according to a prearranged monitoring schedule and VRAP protocols. 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'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.

2.6 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

In 2002, volunteers from the Cold River Local Advisory Committee (CRLAC) began a water quality monitoring program on the Cold River and its tributaries. The goal of this effort was to provide water quality data from the Cold River watershed relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact 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, financial assistance for laboratory costs, and technical assistance.

In 2005 the Cold River watershed experienced one of the worst floods in New Hampshire history. The watershed was severely damaged both in terms of property/infrastructure impacts and alteration of the physical structure of the lower Cold River and Warren Brook. The value of the CRLAC monitoring program became extremely evident as they and NHDES sought to study the impact of the flood on water quality and what short and long term problems resulted. The monitoring conducted in 2009 continues to document the long-term impacts of the 2005 flood and the impacts of natural and anthropogenic restoration.

During 2009, trained volunteers from the CRLAC monitored water quality at 63 stations in the Cold River watershed (Table 3). Stations IDs are designated using a three-letter code to identify the waterbody name plus a number indicating the relative position of the station. The higher the station number the more upstream the station is in the watershed. All surface waters in the Cold River Watershed are designated as Class B waters. This classification is used to apply the appropriate water quality standards.

Water quality monitoring was conducted from March through October. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using a multiparameter In-Situ Troll. Samples for *E.coli*, chloride, total phosphorus, total kjeldahl nitrogen, nitrate, nitrite, and ammonia were taken using bottles supplied by the NHDES laboratory and were stored on ice during transport from the field to the lab. Table 2 summarizes the parameters measured, laboratory standard methods, and equipment used.

Table 2. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	Instantaneous	SM 2550	In-Situ Troll 9000	------
Dissolved Oxygen	Instantaneous	SM 4500 O G	In-Situ Troll 9000	------
pH	Instantaneous	SM 4500 H+	In-Situ Troll 9000	------
Specific Conductance	Instantaneous	SM 2510	In-Situ Troll 9000	------
Turbidity	Instantaneous	EPA 180.1	In-Situ Troll 9000	------
E.coli	Bottle (Sterile)	EPA 1103.1	------	NHDES
Total Phosphorous	Bottle (w/Preservative)	EPA 365.3	------	NHDES
Total Kjeldahl Nitrogen	Bottle (w/Preservative)	EPA 365.3	------	NHDES
Nitrate + Nitrite	Bottle	EPA 353.2	------	NHDES
Ammonia	Bottle (w/Preservative)	EPA 350.1	------	NHDES
Chloride	Bottle	SM D512C	------	NHDES Limnology Center

Table 3. Sampling Stations for the Cold River Watershed, NHDES VRAP, 2009

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation *(Rounded to the Nearest 100 Feet)*
09-CLD NHRIV801070201-06	**B**	**Cold River**	Crescent Lake Road Bridge	Lempster	1200
08-CLD NHRIV801070201-08	**B**	**Cold River**	Allen Road Bridge	Acworth	1000
07-XDB NHRIV801070201-11	**B**	**Unnamed Tributary to Dodge Pond**	Route 10 Bridge	Lempster	1100
06-XDB NHRIV801070201-11	**B**	**Unnamed Tributary to Dodge Pond**	Route 10 Bridge	Lempster	1100
05-XDB NHRIV801070201-11	**B**	**Unnamed Tributary to Dodge Pond**	West Inlet to Dodge Pond Route 10 Bridge	Lempster	1100
02-LRT NHRIV801070201-13	**B**	**Unnamed Tributary to Dodge Brook**	Lovejoy Road	Lempster	100
04-XDB NHRIV801070201-09	**B**	**Unnamed Tributary to Dodge Pond**	South Inlet to Dodge Pond Boy Scout Camp Footbridge	Lempster	1100
03-XDB NHRIV801070201-09	**B**	**Unnamed Tributary to Dodge Pond**	East Inlet to Dodge Pond	Lempster	1200
02-XDB NHRIV801070201-09	**B**	**Unnamed Tributary to Dodge Pond**	North Inlet to Dodge Pond	Lempster	1200
01-XDB NHLAK801070201-02	**B**	**Unnamed Tributary to Dodge Pond**	Dodge Pond Beach	Lempster	1200
07-DOB NHRIV801070201-11	**B**	**Dodge Brook**	Old Road Bridge	Lempster	1110
02-CRT NHRIV801070201-12	**B**	**Unnamed Tributary to Dodge Brook**	Cutler Road	Lempter	1110
05-DOB NHRIV801070201-13	**B**	**Dodge Brook**	Route 10 Bridge	Lempster	1110

05-DOB-PIPE-1 NHRIV801070201-13	**N/A**	**N/A**	Downstream of Culvert on West Side of Route 10	Lempster	1100
01-XJR NHRIV801070201-14	**B**	**Unnamed Tributary to Dodge Brook**	Downstream of Jolly Roger Racetrack	Lempster	1100
01-DOB NHRIV801070201-16	**B**	**Dodge Brook**	East Acworth Road Bridge	Acworth	900
07-HNY NHRIV801070202-01	**B**	**Honey Brook**	Route 123A 500 Yards D/S of Route 10 on Upstream Side of Culvert	Marlow	1000
01-HNY NHRIV801070202-01	**B**	**Honey Brook**	Route 123A Bridge	Acworth	900
01-XHB No AUID at 1 to 100,000	**B**	**Unnamed Tributary to Honey Brook**	Unnamed Tributary to Honey Brook	Acworth	300
07-CLD NHRIV801070202-02	**B**	**Cold River**	Grout Hill Rd Bridge	Acworth	900
01-BOB NHRIV801070202-04	**B**	**Bowers Brook**	Route 123A Bridge	Acworth	700
06-CLD NHRIV801070202-04	**B**	**Cold River**	Route 123A Pulloff	Acworth	700
01-MIB NHRIV801070202-05	**B**	**Milliken Brook**	Route 123A Bridge	Acworth	700
09-THB NHRIV801070202-06	**B**	**Thayer Brook**	Newell Pond Road Bridge	Alstead	1400
02-THB NHRIV801070202-07	**B**	**Thayer Brook**	Forrest Road Bridge	Acworth	800
05A-CLD NHRIV801070202-08	**B**	**Cold River**	Forrest Road Bridge	Acworth	700
01-CAM NHRIV801070202-08	**B**	**Unknown Tributary to Cold River**	Campbell Road	Alstead	1400
06-CRB NHRIV801070202-09	**B**	**Crane Brook**	Crane Brook Road	Acworth	1300
05C-CRB NHRIV801070202-09	**B**	**Crane Brook**	Bsscom Hill Road	Acworth	1100
03-XCB NHRIV801070202-09	**B**	**Bascom Hill Road Tributary**	Downstream of Wetlands	Acworth	1100

01-XCB NHRIV801070202-09	**B**	**Bascom Hill Road Tributary**	Bascom Hill Road	Acworth	1100
05-CRB NHRIV801070202-09	**B**	**Crane Brook**	100 Feet Downstream of Unnamed Tributary at Holden Hill Road	Acworth	1100
01-XCA NHRIV801070202-09	**B**	**Unnamed Tributary to Crane Brook**	Unknown Tributary to Crane Brook	Acworth	900
04-CRB NHRIV801070202-09	**B**	**Crane Brook**	Downstream of Unnamed Tributary	Acworth	900
01-CRB NHRIV801070202-09	**B**	**Crane Brook**	Upstream of Confluence with Cold River	Acworth	600
04M-CLD NHRIV801070202-09	**B**	**Cold River**	McDermott Bridge	Langdon	600
01-XVP No AUID at 1 to 100,000	**B**	**Unnamed Tributary to Vilas Pool**	Unknown Tributary to Vilas Pool	Alstead	600
12-WAB NHRIV801070203-02	**B**	**Warren Brook**	Prentice Hill Road Bridge	Alstead	1200
09-WAB NHRIV801070203-03	**B**	**Warren Brook**	Second Crossing of Route 123 Downstream of Warren Lake Dam	Alstead	1000
07-WAB NHRIV801070203-03	**B**	**Warren Brook**	Route 123 Bridge at Town Barn	Alstead	900
03-CAB NHRIV801070203-03	**B**	**Camp Brook**	Camp Brook Road Bridge	Alstead	800
05-WAB NHRIV801070203-03	**B**	**Warren Brook**	Site of Former Cooper Hill Road Culvert	Alstead	800
03-WAB NHRIV801070203-03	**B**	**Warren Brook**	Route 123 Bridge Just Upstream of Junction with Route 12A	Alstead	600
01-WAB NHRIV801070203-04	**B**	**Warren Brook**	Route 123A Bridge	Alstead	400
03-CLD NHRIV801070203-04	**B**	**Cold River**	Route 123 Bridge	Alstead	400

01-DAB NHRIV801070203-05	**B**	**Darby Brook**	Comstock Road Bridge	Alstead	400
02-CLD NHRIV801070203-09	**B**	**Cold River**	Drewsville - Route 123 Bridge	Walpole	400
02-CLD-PIPE NHRIV801070203-09	**N/A**	**N/A**	Drewsville - Route 123 Bridge	Walpole	400
01-LBK NHRIV801070203-07	**B**	**Unnamed Tributary to Little Brook**	Ball Hill Road	Langdon	700
01-XLB NHRIV801070203-07	**B**	**Great Brook**	Ball Hill Road	Langdon	500
03A-GRB NHRIV801070203-07	**B**	**Great Brook**	100 Feet Upstream from Little Brook	Acworth	500
02-XGB NHRIV801070203-08	**B**	**Unknown Tributary to Great Brook**	Route 12A	Langdon	500
03-GRB NHRIV801070203-07	**B**	**Great Brook**	Route 12A Bridge at Ball Hill Road	Langdon	500
02-GRB NHRIV801070203-08	**B**	**Great Brook**	Covered Bridge on Cheshire Turnpike	Langdon	400
07-RAB NHRIV801070203-08	**B**	**Ram Brook**	Route 12 DS Side of Culvert	Langdon	400
03-RAB NHRIV801070203-08	**B**	**Ram Brook**	Jewett Road	Langdon	400
07-BMB NHRIV801070203-08	**B**	**Brush Meadow Brook**	Brush Meadow Brook at FMRHS Entrance DS Side of Culvert	Langdon	400
03-BMB NHRIV801070203-08	**B**	**Brush Meadow Brook**	Jewett Road	Langdon	400
01-JEB NHRIV801070203-08	**B**	**Jewett Brook**	50' US of Confluence with Great Brook	Langdon	400
01P-GRB NHRIV801010805-06	**B**	**Great Brook**	50 Feet Downstream of Jewett Brook	Langdon	400
01-GRB NHRIV801070203-08	**B**	**Great Brook**	Cold River Road Bridge	Langdon	400
01-MTB NHRIV801070203-10	**B**	**Mountain Brook**	Cold River Road Bridge	Walpole	300
01-CLD NHRIV801070203-12	**B**	**Cold River**	Arch Bridge	Walpole	200
00H-CLD NHRIV801070203-12	**B**	**Cold River**	Route 12 Bridge	Walpole	200

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 pH

Between one and three measurements were taken in the field for pH at 57 stations in the Cold River watershed [Table 4]. Of the 133 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 4. pH Data Summary – Cold River Watershed, 2009

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-CLD	2	6.54 - 6.76	0	2
08-CLD	3	5.75 - 6.28	3	3
07-XDB	1	4.70	1	1
06-XDB	2	6.45 - 6.92	1	2
05-XDB	1	5.64	1	1
02-LRT	2	5.18 - 5.93	2	2
04-XDB	1	4.53	1	1
03-XDB	2	4.81 - 5.56	2	2
02-XDB	2	4.22 - 4.45	2	2
01-XDB	3	5.67 - 5.99	3	3
07-DOB	3	5.03 - 5.59	3	3
02-CRT	2	4.77 - 5.70	2	2
05-DOB	3	5.14 - 6.01	3	3
05-DOB-PIPE-1	1	5.19	0[A]	1
01-XJR	1	5.54	1	1
01-DOB	3	5.64 - 6.57	1	3
07-HNY	2	5.12 - 5.86	2	2
01-HNY	3	5.61 - 6.72	1	3
07-CLD	3	6.04 - 6.90	1	3
01-BOB	3	6.22 - 6.87	1	3
06-CLD	2	6.21 - 7.21	1	2
01-MIB	3	6.63 - 7.47	0	3

09-THB	3	6.29 - 6.80	2	3
02-THB	3	6.31 - 6.84	1	3
05A-CLD	3	6.29 - 7.03	1	3
01-CAM	3	6.73 - 6.97	0	3
05C-CRB	2	6.79 - 6.81	0	2
01-XCB	3	7.03 - 7.25	0	3
05-CRB	2	6.42 - 6.77	1	2
01-XCA	1	7.29	0	1
04-CRB	1	7.29	0	1
01-CRB	3	6.77 - 7.09	0	3
04M-CLD	3	6.25 - 7.11	1	3
01-XVP	2	6.42 - 6.93	1	2
12-WAB	3	6.24 - 6.49	3	3
09-WAB	2	6.40 - 6.42	2	2
07-WAB	3	6.54 - 6.66	0	3
03-CAB	3	5.01 - 6.10	3	3
05-WAB	3	6.14 - 6.33	3	3
03-WAB	3	6.39 - 6.73	1	3
01-WAB	3	6.51 - 7.17	0	3
03-CLD	3	6.50 - 7.34	0	3
01-DAB	3	6.49 - 6.95	1	3
02-CLD	3	6.60 - 6.88	0	3
02-CLD-PIPE	1	6.81	0[A]	1
01-LBK	1	6.74 - 6.74	0	1
01-XLB	2	6.89 - 7.11	0	2
03A-GRB	1	6.96 - 6.96	0	1
02-XGB	1	6.51 - 6.51	0	1
03-GRB	3	6.34 - 6.86	1	3
02-GRB	3	6.74 - 6.94	0	3
07-RAB	2	7.04 - 7.29	0	2
03-RAB	3	6.20 - 6.34	3	3
07-BMB	3	6.10 - 6.27	3	3
03-BMB	3	6.57 - 6.76	0	3
01-GRB	3	6.89 - 6.98	0	3
01-MTB	3	6.23 - 6.86	1	3
01-CLD	3	6.36 - 6.94	1	3
00H-CLD	1	7.04	0	1
Total	**139**	_____	**61**	**139**

[A] Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.

A majority of stations (particularly in the upper watershed) had at least one measurement below the New Hampshire Class B surface water quality standard minimum (Figure 1).

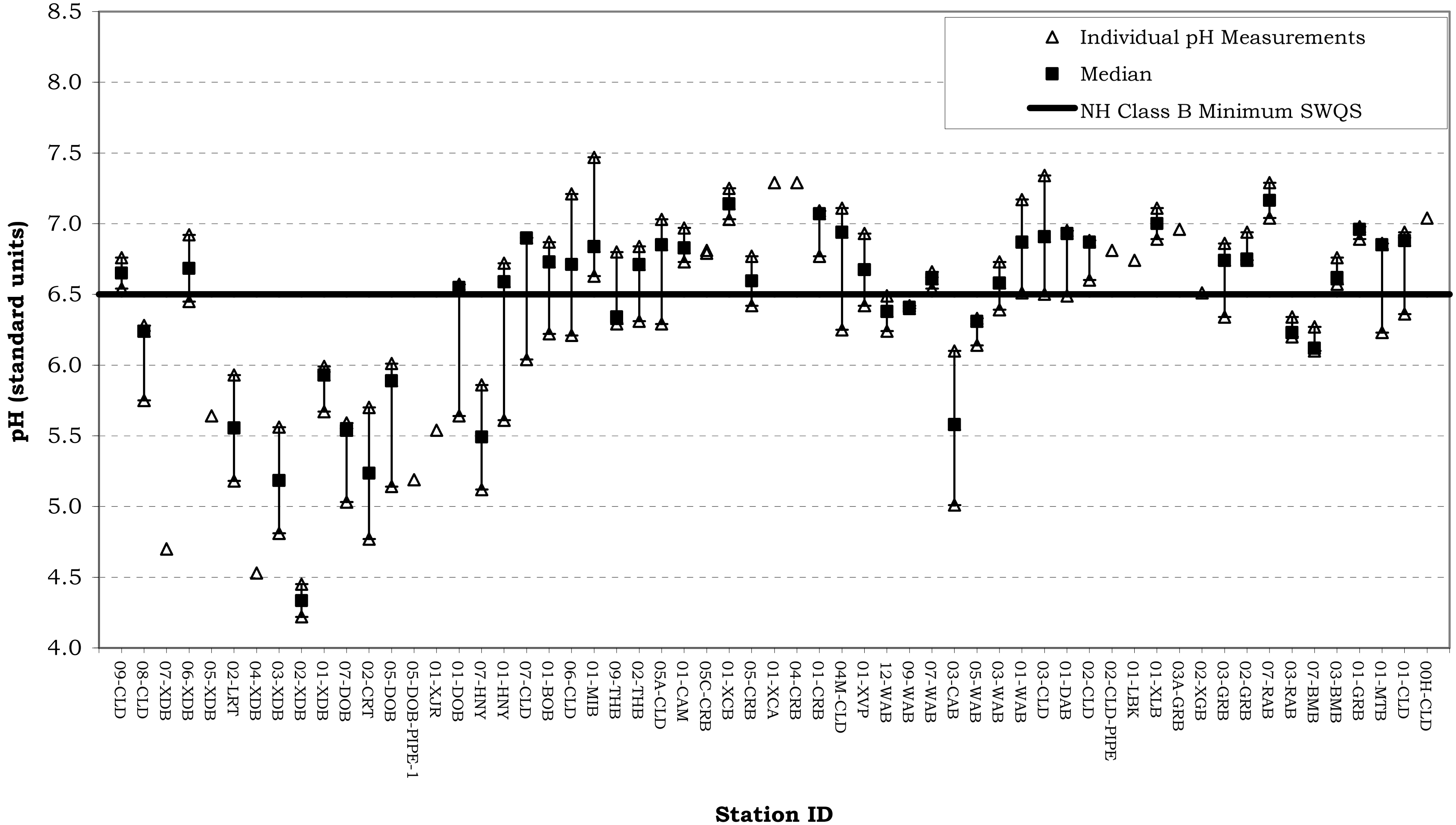
Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally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

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.

Figure 1. pH Statistics for the Cold River Watershed
July 30 - October 20, 2009, NHDES VRAP



4.2 Turbidity

Between one and 10 measurements were taken in the field for turbidity at 58 stations in the Cold River watershed [Table 5]. Of the 292 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 background. Samples that exceeded the 2009 average for a given station by more than 10 NTU are designated as "potentially not meeting standards". Higher turbidity measurements may be naturally occurring as they are influenced by precipitation, soil type, the composition of the streambed and the geology of the streambed.

Table 5. Turbidity Data Summary – Cold River Watershed, 2009

Station ID	Samples Collected	Data Range (standard units)	Acceptable Samples Potentially Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
09-CLD	2	0.90 - 0.95	0	2
08-CLD	7	0.85 - 1.80	0	7
07-XDB	5	0.60 - 2.00	0	5
06-XDB	7	0.6 - 2.10	0	7
05-XDB	5	0.70 - 1.10	0	5
02-LRT	7	0.80 - 1.20	0	7
04-XDB	2	0.55 - 0.70	0	2
03-XDB	7	0.40 - 0.80	0	7
02-XDB	7	0.55 - 0.95	0	7
01-XDB	5	0.60 - 2.10	0	5
07-DOB	8	0.65 - 3.00	0	8
02-CRT	7	0.60 - 1.00	0	7
05-DOB	8	0.60 - 1.70	0	8
05-DOB-PIPE-1	5	1.10 - 180	0[A]	5
01-XJR	3	0.95 - 7.20	0	3
01-DOB	8	0.55 - 1.30	0	8
07-HNY	7	0.75 - 1.20	0	7
01-HNY	8	0.50 - 1.40	0	8
01-XHB	3	0.55 - 0.75	0	3
07-CLD	8	1.00 - 1.50	0	8
01-BOB	8	0.85 - 22.0	1	8
06-CLD	6	0.95 - 5.90	0	6
01-MIB	8	0.55 - 11.0	0	8

09-THB	3	0.70 - 0.85	0	3
02-THB	5	0.55 - 2.40	0	5
05A-CLD	7	0.70 - 11.00	0	7
01-CAM	4	1.10 - 6.90	0	4
05C-CRB	2	0.85 - 1.00	0	2
01-XCB	3	1.00 - 3.8	0	3
05-CRB	2	0.80 - 3.00	0	2
04-CRB	1	1.10 - 1.10	0	1
01-CRB	6	0.60 - 5.40	0	6
04M-CLD	5	0.90 - 10.0	0	5
01-XVP	6	0.80 - 4.10	0	6
12-WAB	6	1.10 - 2.30	0	6
09-WAB	4	0.70 - 3.80	0	4
07-WAB	5	0.70 - 5.20	0	5
03-CAB	8	0.85 - 5.10	0	8
05-WAB	5	1.60 - 6.20	0	5
03-WAB	5	1.70 - 17.0	1	5
01-WAB	10	1.40 - 41.0	2	10
03-CLD	6	0.85 - 9.80	0	6
01-DAB	3	0.90 - 5.90	0	3
02-CLD	5	0.85 - 14.0	0	5
02-CLD-PIPE	3	1.50 - 8.20	0[A]	3
01-LBK	1	2.20 - 2.20	0	1
01-XLB	2	2.20 - 7.30	0	2
03A-GRB	1	3.40 - 3.40	0	1
03-GRB	4	0.95 - 3.30	0	4
02-GRB	4	0.60 - 4.20	0	4
07-RAB	3	1.70 - 3.20	0	3
03-RAB	5	0.85 - 3.80	0	5
07-BMB	7	1.10 - 9.10	0	7
03-BMB	7	1.40 - 4.70	0	7
01-GRB	5	0.80 - 5.30	0	5
01-MTB	3	0.90 - 3.70	0	3
01-CLD	4	0.75 - 18.0	1	4
00H-CLD	1	2.20 - 2.20	0	1
Total	**292**	_____	**5**	**292**

[A] Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.

Turbidity levels were generally low throughout the watershed though some stations had elevated levels. Two stations in the Warren Brook watershed (03-WAB and 01-WAB), one on Bowers Brook (01-BOB) and one on the mainstem of the Cold River (01-CLD) had one or more elevated turbidity measurements.

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.

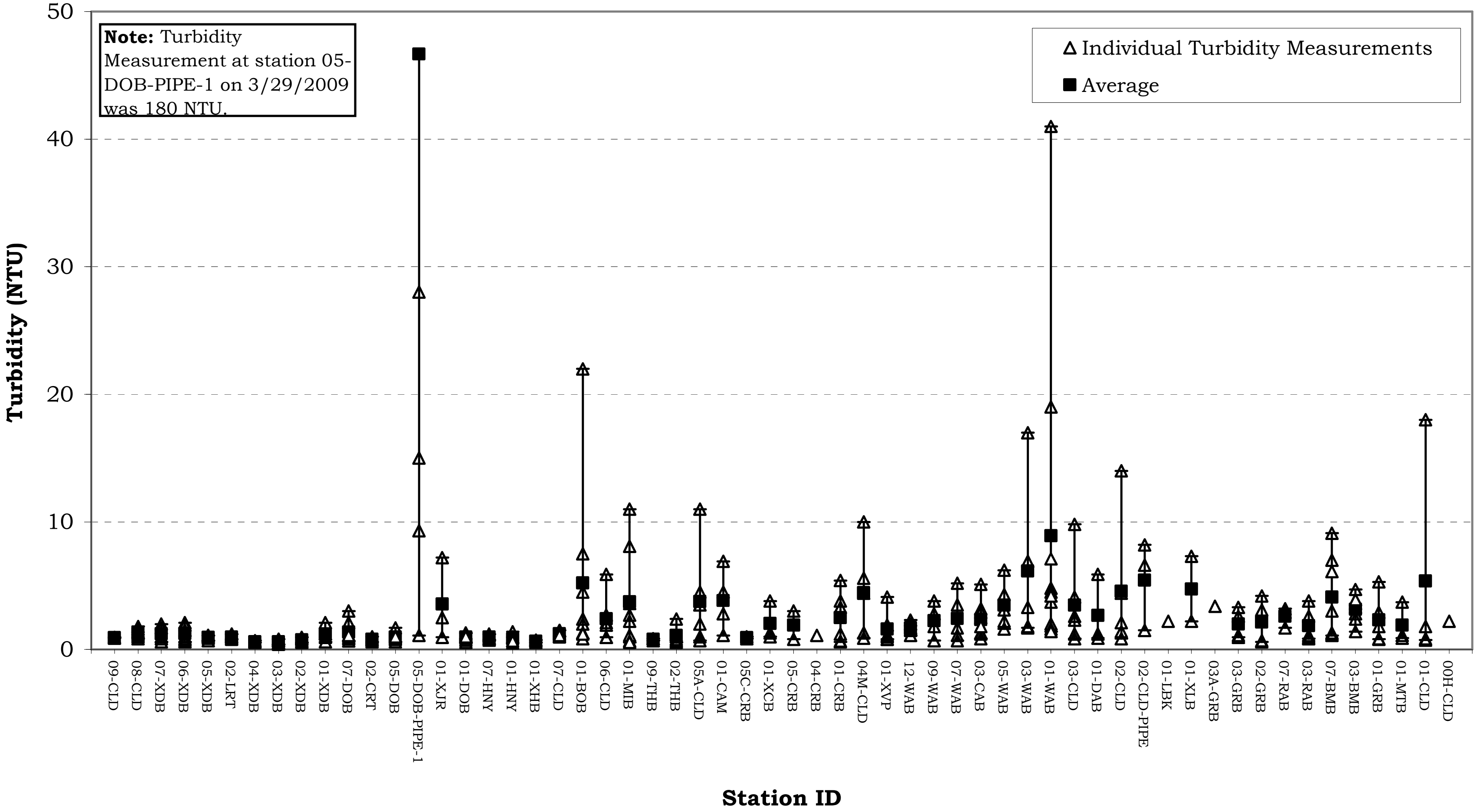
Recommendations

- 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. This is especially critical in those areas most impacted by the 2005 flood. Turbidity monitoring should be conducted within restored areas to see if bank stabilization projects succeed in lowering turbidity levels during precipitation events.

- 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.

Figure 2. Turbidity Statistics for the Cold River Watershed March 07 - October 20, 2009, NHDES VRAP



4.3 Specific Conductance

Between one and 10 measurements were taken in the field for specific conductance at 63 stations in the Cold River watershed [Table 6]. Of the 315 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 6. Specific Conductance Data Summary – Cold River Watershed, 2009

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-CLD	2	32.5 - 34.2	0	2
08-CLD	7	36.6 - 48.7	0	7
07-XDB	6	46.9 - 763	0	6
06-XDB	7	56.2 - 171	0	7
05-XDB	7	188 - 373	0	7
02-LRT	7	36.8 - 70.3	0	7
04-XDB	5	30.3 - 49.7	0	5
03-XDB	7	54.1 - 102	0	7
02-XDB	7	43.5 - 71.0	0	7
01-XDB	5	49.5 - 97.2	0	5
07-DOB	8	51.1- 80.4	0	8
02-CRT	7	31.3 - 80.1	0	7
05-DOB	8	40.0 - 83.0	0	8
05-DOB-PIPE-1	5	40.5 - 425	0[A]	5
01-XJR	3	18.6 - 20.2	0	3
01-DOB	8	33.6 - 81.1	0	8
07-HNY	7	46.0 - 117	0	7
01-HNY	8	27.9 - 70.6	0	8
01-XHB	3	17.9 - 22.9	0	3
07-CLD	8	35.1 - 62.1	0	8
01-BOB	8	27.8 - 39.2	0	8
06-CLD	6	34.9 - 56.1	0	6
01-MIB	8	36.8 - 60.1	0	8
09-THB	3	26.3 - 30.4	0	3
02-THB	5	25.6 - 42.4	0	5
05A-CLD	7	35.0 - 65.5	0	7
01-CAM	4	39.3 - 65.0	0	4
06-CRB	1	39.4	0	1

05C-CRB	3	50.3 – 68.0	0	3
01-XCB	3	127 - 207	0	3
05-CRB	2	40.7 - 76.3	0	2
01-XCA	1	143	0	1
04-CRB	1	85.3	0	1
01-CRB	6	61.2 - 82.6	0	6
04M-CLD	5	35.2 - 65.9	0	5
01-XVP	6	29.6 - 58.3	0	6
12-WAB	6	41.5 - 51.6	0	6
09-WAB	4	41.8 - 53.4	0	4
07-WAB	5	40.7 - 52.1	0	5
03-CAB	8	31.8 - 65.7	0	8
05-WAB	5	44.9 - 67.8	0	5
03-WAB	5	46.3 - 77.8	0	5
01-WAB	10	47.9 - 84.9	0	10
03-CLD	6	38.1 - 71.2	0	6
01-DAB	3	42.19 - 85.9	0	3
02-CLD	5	39.7 - 77.1	0	5
02-CLD-PIPE	3	97.7 - 127.2	0[A]	3
01-LBK	2	76.5 - 116.0	0	2
01-XLB	4	282.6 - 452.2	0	4
03A-GRB	2	56.7 - 64.3	0	2
02-XGB	2	159.0 - 162.5	0	2
03-GRB	5	56.5 - 67.0	0	5
02-GRB	5	58.1 - 70.3	0	5
07-RAB	3	87.0 - 107.4	0	3
03-RAB	7	120.8 - 152.2	0	7
07-BMB	8	97.9 - 228.4	0	8
03-BMB	8	114.7 - 185.5	0	8
01-JEB	1	56.6	0	1
01P-GRB	1	81.1	0	1
01-GRB	5	50.1 - 85.2	0	5
01-MTB	3	18.1 - 40.8	0	3
01-CLD	4	41.3 - 85.3	0	4
00H-CLD	1	60.5	0	1
Total	**315**	_____	**0**	**315**

[A] Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.

Specific conductance levels were variable, although the majority of waterbodies and stations monitored had relatively low measurements (Figure 3). The Dodge Brook, Crane Brook, and Great Brook watersheds had stations with elevated specific conductance levels. These variable specific conductance levels in the Cold River watershed indicate low pollutant levels at most monitoring stations but potentially higher pollutant levels in some of the tributaries to the Cold River. Continued investigation into the higher specific conductance levels is warranted.

Higher specific conductance levels can be indicative of pollution from sources such as urban/agricultural runoff, road salt, failed septic systems, or groundwater pollution. The variable specific conductance levels indicate low pollutant levels at some stations and high pollutant levels at others.

During 2009 the Cold River Local Advisory Committee also monitored specific conductance during the winter and early spring months to more fully assess the watershed for both specific conductance and chloride. Chloride and specific conductance are very closely related to one another and the protocols NHDES uses to assess waterbodies allows specific conductance to be used as a formal surrogate for chloride. Monitoring for specific conductance and chloride in the winter and early spring months will help determine what the impact of road salt application is in the watershed and indicated what time of year chloride levels tend to be highest. Specific conductance measurements taken during the winter and snowmelt months are indicated with a separate color in Figure 3.

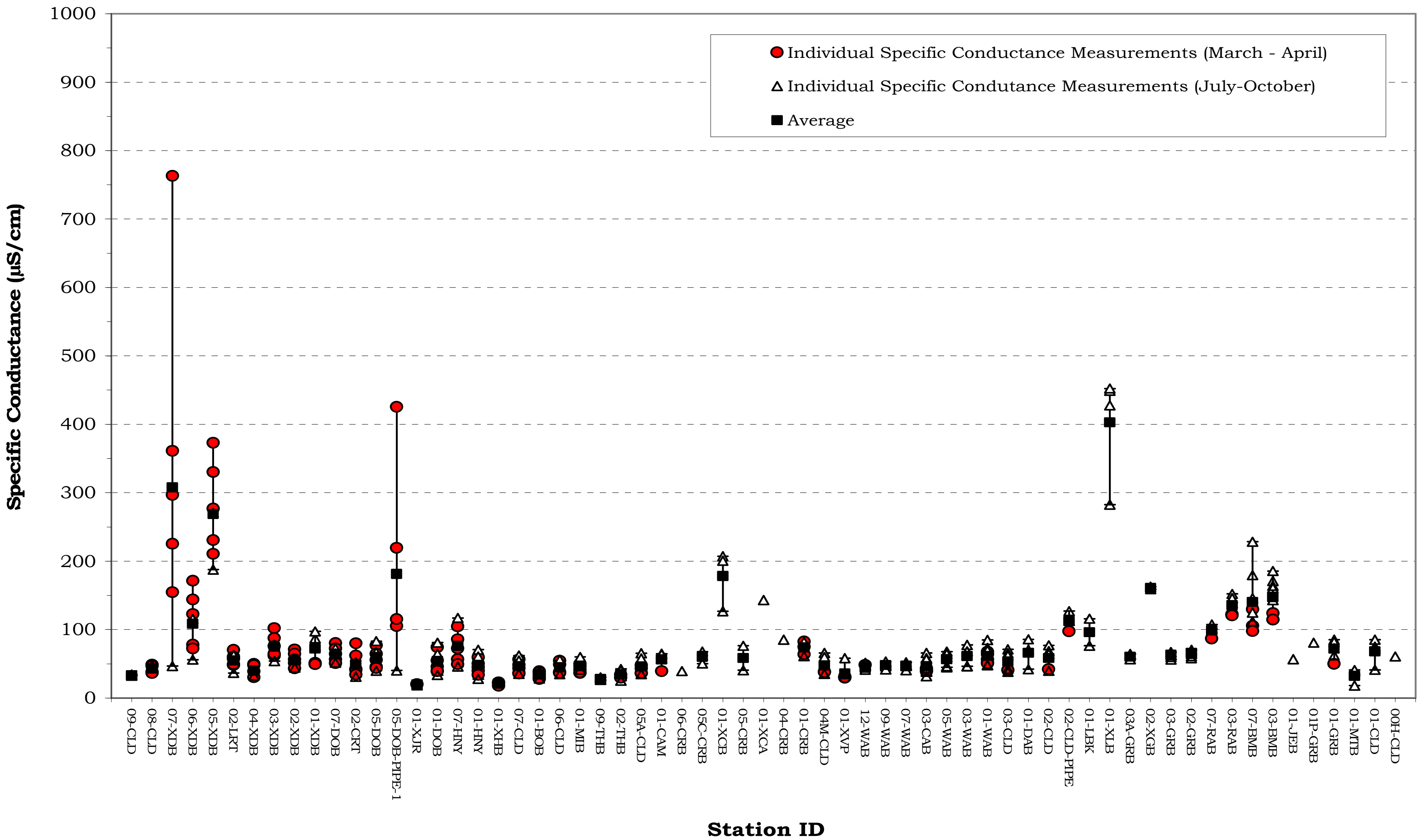
Recommendations

- 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.

Figure 3. Specific Conductance Statistics for the Cold River Watershed
March 7 - October 20, 2009, NHDES VRAP



4.4 Water Temperature

Between one and 10 measurements were taken in the field for water temperature at 62 stations in the Cold River watershed [Table 7]. Of the 313 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 7. Water Temperature Data Summary – Cold River Watershed, 2009

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-CLD	2	25.9 - 28.7	Not Applicable	2
08-CLD	7	0.8 - 26.7	N/A	7
07-XDB	6	0.8 - 18.1	N/A	6
06-XDB	7	0.9 - 17.9	N/A	7
05-XDB	6	0.5 - 19.5	N/A	6
02-LRT	7	0.2 - 19.5	N/A	7
04-XDB	5	1.5 - 18.5	N/A	5
03-XDB	7	0.3 - 18.4	N/A	7
02-XDB	7	0.4 - 20.8	N/A	7
01-XDB	5	1.2 - 29.4	N/A	5
07-DOB	8	0.5 - 26.0	N/A	8
02-CRT	7	0.5 - 19.6	N/A	7
05-DOB	8	0.4 - 22.6	N/A	8
05-DOB-PIPE-1	5	1.0 - 20.1	N/A	5
01-XJR	3	3.0 - 17.3	N/A	3
01-DOB	8	0.3 - 22.1	N/A	8
07-HNY	7	2.5 - 19.8	N/A	7
01-HNY	8	1.3 - 19.1	N/A	8
01-XHB	3	1.8 - 3.6	N/A	3
07-CLD	8	0.7 - 24.3	N/A	8
01-BOB	8	1.4 - 21.9	N/A	8
06-CLD	6	0.5 - 20.3	N/A	6
01-MIB	8	1.0 - 21.4	N/A	8
09-THB	3	15.3 - 29.1	N/A	3

02-THB	5	1.0 - 19.6	N/A	5
05A-CLD	7	1.3 - 24.1	N/A	7
01-CAM	4	4.2 - 22.2	N/A	4
06-CRB	1	13.8	N/A	1
05C-CRB	3	11.6 - 20.5	N/A	3
01-XCB	3	11.6 - 21.0	N/A	3
05-CRB	2	11.4 - 19.8	N/A	2
01-XCA	1	11.2	N/A	1
04-CRB	1	11.2	N/A	1
01-CRB	6	1.7 - 21.9	N/A	6
04M-CLD	5	3.4 - 24.5	N/A	5
01-XVP	6	3.5 - 20.8	N/A	6
12-WAB	6	5.1 - 27.5	N/A	6
09-WAB	4	8.7 - 24.7	N/A	4
07-WAB	5	8.7 - 23.6	N/A	5
03-CAB	7	3.4 - 23.0	N/A	7
05-WAB	5	8.6 - 24.2	N/A	5
03-WAB	5	8.6 - 25.8	N/A	5
01-WAB	10	3.00- 26.3	N/A	10
03-CLD	6	4.2 - 23.6	N/A	6
01-DAB	3	10.9 - 19.3	N/A	3
02-CLD	5	4.4 - 22.4	N/A	5
02-CLD-PIPE	3	7.1 - 16.7	N/A	3
01-LBK	2	15.4 - 19.7	N/A	2
01-XLB	4	12.2 - 21.9	N/A	4
03A-GRB	2	13.3 - 18.8	N/A	2
02-XGB	2	11.1 - 13.7	N/A	2
03-GRB	5	10.5 - 19.6	N/A	5
02-GRB	5	10.4 - 18.9	N/A	5
07-RAB	3	4.7 - 21.3	N/A	3
03-RAB	7	6.8 - 14.0	N/A	7
07-BMB	8	3.7 - 25.8	N/A	8
03-BMB	8	4.8 - 19.5	N/A	8
01-JEB	1	11.9	N/A	1
01-GRB	6	4.7 - 19.1	N/A	6
01-MTB	3	9.0 - 19.7	N/A	3
01-CLD	4	10.4 – 21.0	N/A	4
00H-CLD	1	21.2	N/A	1
Total	**313**	_____	**N/A**	**313**

Figure 4 shows the results of instantaneous water temperature measurements taken at 62 stations in the Cold River watershed. The average water temperature varied from 2.80 °C. to 27.32 °C.

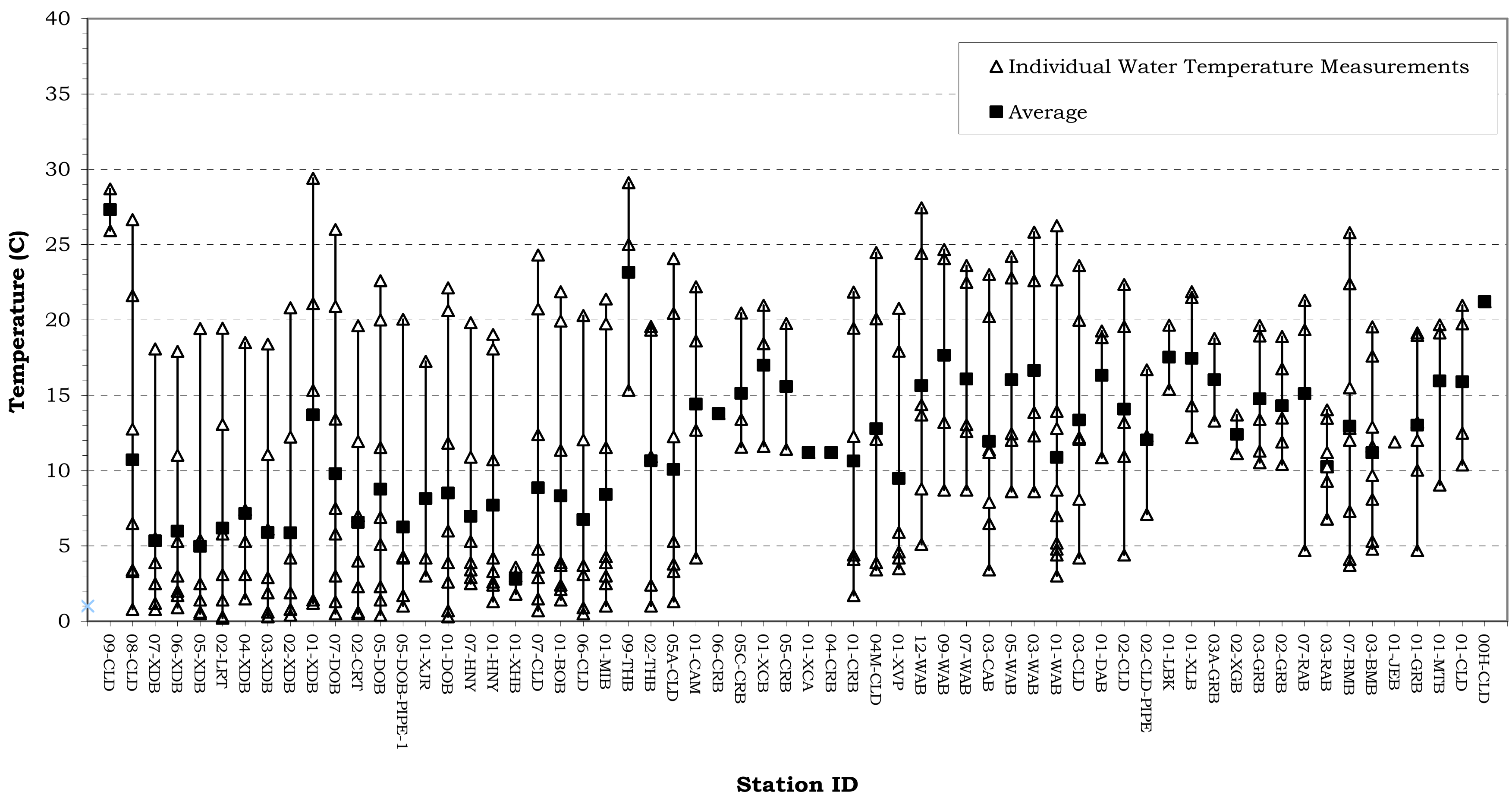
Water temperature is a critical parameter for aquatic life and has an impact on other water quality parameters such as dissolved oxygen concentrations, and the activity of bacteria in the water. Water temperature controls the metabolic and reproductive processes of aquatic species and can determine which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

Recommendations

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

Figure 4. Water Temperature Statistics for the Cold River Watershed March 07 - October 20, 2009, NHDES VRAP



4.5 *Escherichia coli*/Bacteria

One sample was taken for *Escherichia coli* (*E. coli*) at four stations in the Crane Brook watershed in Acworth (Table 8). All four samples 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 8. *E.coli* Data Summary – Crane Brook Watershed, 2009

Station ID	Samples Collected	Data Range (counts/100 mL)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
06-CRB	1	10	0	1
03-XCB	1	40	0	1
01-XCB	1	30	0	1
05-CRB	1	<10	0	1
Total	**4**	____	**0**	**4**

All four stations samples for *E.coli* met the state of New Hampshire Class B surface water quality standard.

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

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. As only one sample was collected at each station, no geometric mean was calculated.

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).
- Continue to document river conditions and station characteristics (including the presence of wildlife in the area during sampling).At stations with particularly high bacteria levels volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated bacteria levels. Those sampling should also look for any potential sources of bacteria such as emission pipes, failed septic systems, farm animals, pet waste, wildlife and waterfowl.

4.6 Total Phosphorus

One sample was taken in the field for total phosphorus at 13 stations in the Crane Brook and Great Brook watersheds (Table 9). Of the 13 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.

There is no numeric standard for total phosphorus for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no phosphorus in such concentrations that would impair any existing or designated uses." The NHDES "level of concern" for total phosphorous is 0.05 mg/L.

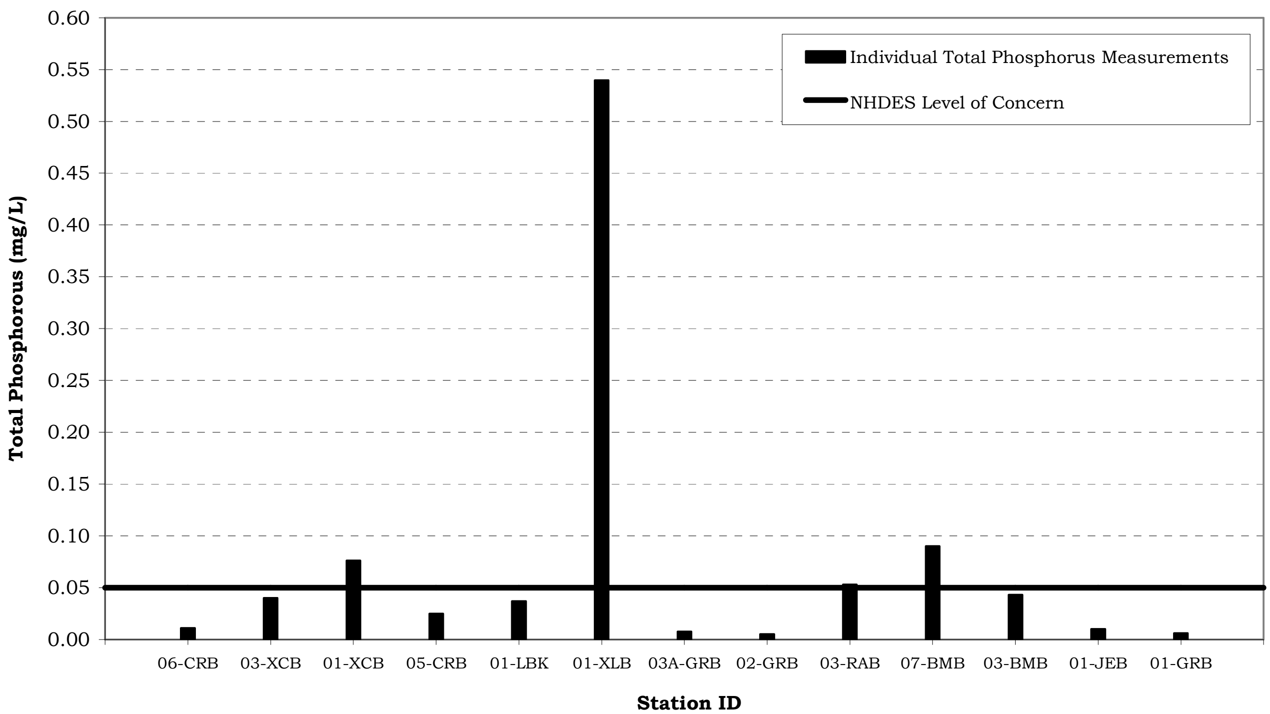
Table 9. Total Phosphorus Data Summary – Crane Brook/Great Brook Watersheds, 2009

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Above NHDES Level of Concern	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
06-CRB	1	0.011	0	1
03-XCB	1	0.040	0	1
01-XCB	1	0.076	1	1
05-CRB	1	0.025	0	1
01-LBK	1	0.037	0	1
01-XLB	1	0.540	1	1
03A-GRB	1	0.008	0	1
02-GRB	1	0.005	0	1
03-RAB	1	0.053	1	1
07-BMB	1	0.090	1	1
03-BMB	1	0.043	0	1
01-JEB	1	0.0100	0	1
01-GRB	1	0.006	0	1
Total	**13**	_____	**4**	**13**

Measurements at one station in the Crane Brook watershed (01-XCB) and three stations in the Great Brook watershed (01-XLB, 03-RAB, and 07-BMB) exceeded the NHDES "level of concern" (Figure 5). Under undisturbed natural conditions phosphorous is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorous, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorous is increased due to human activity, algae respond with significant growth.

A major source of excessive phosphorous concentrations in aquatic ecosystems can be wastewater treatment facilities, as sewage typically contains relatively high levels of phosphorus detergents. However, fertilizers used on lawns and agricultural areas can also contribute significant amounts of phosphorus.

Figure 5. Total Phosphorus Statistics for the Cold River Watershed
September 29, 2009, 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.

4.7 Total Nitrogen:

Total Kjeldahl Nitrogen (TKN) + Nitrate (NO_3)/Nitrite (NO_2)

One sample was taken in the field for both total kjeldahl nitrogen (TKN) and NO_3(nitrate) + (nitrite) NO_2 at four stations in the Crane Brook watershed and four stations in the Great Brook watershed (Table 10 and Table 11). When these two parameters are combined one can report "total nitrogen" and thus TKN and nitrate/nitrite are combined into one report section. There were five additional stations in the Great Brook watershed that were sampled for NO_3+NO_2 but not for TKN. All samples collected for both TKN and NO_3+NO_2 met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

There is no numeric standard for nitrogen for Class B waters. The narrative standard states that "unless naturally occurring, shall contain no nitrogen in such concentrations that would impair any existing or designated uses."

Table 10. TKN (mg/L) Data Summary – Crane Brook/Great Brook Watersheds, 2009

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
06-CRB	1	0.31	Not Applicable	1
03-XCB	1	0.30	N/A	1
01-XCB	1	0.36	N/A	1
05-CRB	1	0.26	N/A	1
01-LBK	1	0.37	N/A	1
03-RAB	1	ND[A]	N/A	1
07-BMB	1	0.78	N/A	1
03-BMB	1	0.38	N/A	1
Total	**4**	_____	**N/A**	**4**

[A] Non-Detect. NHDES Laboratory detection limit for TKN is 0.25 mg/L

Table 11. Nitrate+Nitrite Data Summary – Crane Brook/Great Brook Watershed, 2009

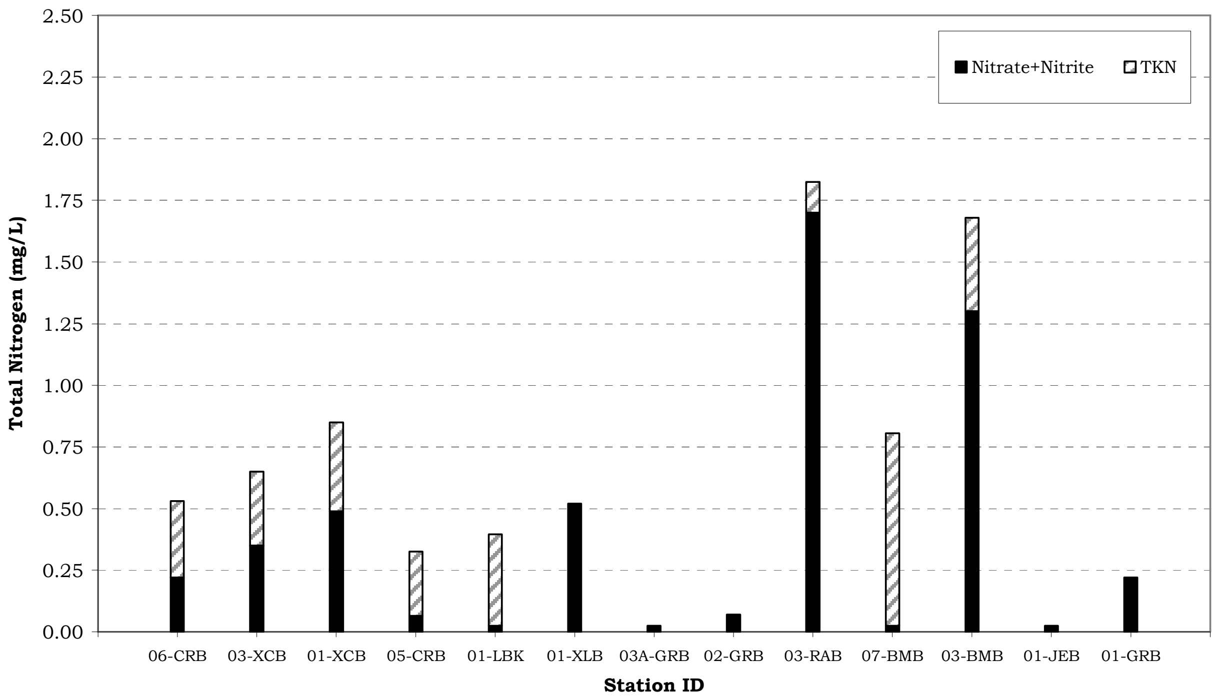
Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
06-CRB	1	0.22	Not Applicable	1
03-XCB	1	0.35	N/A	1
01-XCB	1	0.49	N/A	1
05-CRB	1	0.066	N/A	1
01-LBK	1	ND[A]	N/A	1
01-XLB	1	0.52	N/A	1
03A-GRB	1	ND[A]	N/A	1
02-GRB	1	0.07	N/A	1
03-RAB	1	1.70	N/A	1
07-BMB	1	ND[A]	N/A	1
03-BMB	1	1.30	N/A	1
01-JEB	1	ND[A]	N/A	1
01-GRB	1	0.22	N/A	1
Total	**13**	_____	**N/A**	**13**

[A] Non-Detect. NHDES Laboratory detection limit for nitrate + nitrite is 0.05 mg/L

Total nitrogen is comprised of dissolved inorganic nitrogen (nitrate, nitrite, and ammonia) combined with organic nitrogen. A numeric value for total nitrogen can be derived by adding TKN with NO_3+NO_2 (Figure 7).

Although there is no numeric standard for total nitrogen, the median TKN value for New Hampshire rivers and streams is 0.41 mg/L (based on VRAP and other NHDES data collected 2004 - 2008). One station (07-BMB exceeded the TKN state median. The median NO_3+NO_2 value for New Hampshire rivers and streams is 0.17 mg/L (based on VRAP and other NHDES data collected 2004 - 2008). Three stations in the Crane Brook watershed (06-CRB, 03-XCB, and 01-XCB) and four stations in the Great Brook watershed (01-XLB, 03-RAB, 03-BMB, and 01-GRB) exceeded the NO_3+NO_2 state median.

Figure 6. Total Nitrogen (mg/L) Statistics for the Cold River Watershed
September 29, 2009, NHDES VRAP



Nitrogen is naturally occurring in soil in organic forms from decomposing plant and animal matter. Bacteria in the soil then convert nitrogen to nitrate, a nitrogen-oxygen chemical unit. Primary sources which can cause increased nitrate levels are human sewage, livestock manure, and agricultural fertilizers. Higher TKN values may also be indicative of high production rates, algal growth and decomposing organics.

Recommendations

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

4.8 Ammonia (NH_3)

One sample was taken for ammonia (NH_3) at four stations in the Crane Brook watershed [Table 12]. All four samples 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 ammonia is dependent on the temperature and pH of the sample.

Table 12. Ammonia Data Summary – Cold River Watershed, 2009

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
06-CRB	1	ND[A]	0	1
03-XCB	1	ND[A]	0	1
01-XCB	1	ND[A]	0	1
05-CRB	1	ND[A]	0	1
Total	**4**	_____	**N/A**	**4**

[A] Non-Detect. NHDES Laboratory detection limit for nitrate + nitrite is 0.05 mg/L

All the stations sampled were below the NHDES laboratory detection limit.

4.9 Chloride

Between one and two samples were taken for chloride at 25 stations in the Cold River watershed [Table 13]. Of the 25 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

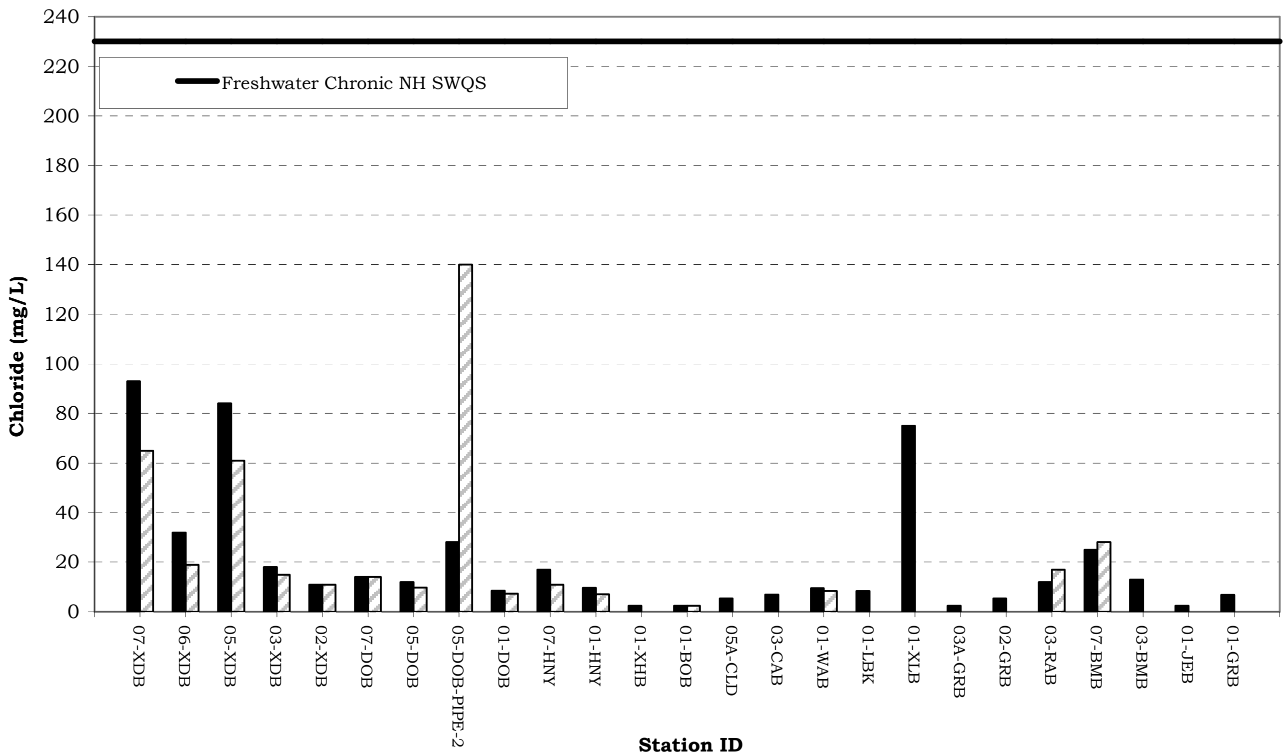
Table 13. Chloride Data Summary – Cold River Watershed, 2009

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
07-XDB	2	65 - 93	0	2
06-XDB	2	19 - 32	0	2
05-XDB	2	61 - 84	0	2
03-XDB	2	15 - 18	0	2
02-XDB	2	11 - 11	0	2
07-DOB	2	14 - 14	0	2
05-DOB	2	9.7 - 12	0	2
05-DOB-PIPE-2	2	28 - 140	0	2
01-DOB	2	7.3 - 8.5	0	2
07-HNY	2	11 - 17	0	2
01-HNY	2	7.1 - 9.6	0	2
01-XHB	1	2.5	0	1
01-BOB	2	2.5 - 2.5	0	2
05A-CLD	1	5.4	0	1
03-CAB	1	7	0	1
01-WAB	2	8.4 - 9.5	0	2
01-LBK	1	8.4	0	1
01-XLB	1	75	0	1
03A-GRB	1	2.5	0	1
02-GRB	1	5.3	0	1
03-RAB	2	12 - 17	0	2
07-BMB	2	25 - 28	0	2
03-BMB	1	13	0	1
01-JEB	1	2.5	0	1
01-GRB	1	6.8	0	1
Total	**40**	_____	**0**	**40**

All samples taken for chloride were below the state of New Hampshire Class B chronic surface water quality standard of 230 mg/L (Figure 8).

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 7. Chloride Statistics for the Cold River Watershed
March 27 - September 29, 2009, 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.

APPENDIX A: 2009 COLD RIVER WATERSHED VRAP DATA

Legend	
(blue)	Measurements not meeting New Hampshire surface water quality standards
(yellow)	Turbidity measuremets potentially not meeting New Hampshire surface water quality standards
(pink)	Total Phosphorous measurements exceeding NHDES level of concern
(diagonal line)	Measurements not meeting NHDES quality assurance/quality control standards

[A] Chronic water quality standard

[B] Hardness dependent metal. The water quality standard is caluculated based on the site specific hardness value.

09-CLD, Cold River, Crescent Lake Road Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (μS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(μS/cm as chloride surrogate)	Narrative
07/30/2009	18:45	6.54	0.90	34.2	25.9
08/19/2009	15:39	6.76	0.95	32.5	28.7

08-CLD, Cold River, Allen Road Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (μS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(μS/cm as chloride surrogate)	Narrative
03/07/2009	13:10		1.10	48.7	0.8
03/16/2009	16:30		1.00	46.9	3.3
03/29/2009	13:25		1.20	38.1	3.4
04/03/2009	14:35		0.85	36.6	6.5
07/30/2009	18:33	5.75	1.40	43.4	21.6
08/19/2009	15:26	6.28	1.80	44.6	26.7
10/06/2009	16:17	6.24	1.60	47.6	12.8

07-XDB, Unnamed Tributary to Dodge Pond, Route 10 Bridge, Lempter

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	14:00			763.0	0.8	
03/16/2009	17:20		2.00	361.3	1.2	
03/27/2009	14:55		0.60	296.8	3.9	93
03/29/2009	12:35		1.70	225.4	2.5	65
04/03/2009	16:30		0.85	154.6	5.5	
07/30/2009	19:32	4.70	1.00	46.9	18.1	

06-XDB, Unnamed Tributary to Dodge Pond, Route 10 Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	13:55		0.75	171.3	0.9	
03/16/2009	17:15		0.85	144.0	1.7	
03/27/2009	14:50		1.50	122.7	3.0	32
03/29/2009	12:45		1.90	78.0	2.0	19
04/03/2009	15:50		2.10	72.4	5.3	
07/30/2009	19:27	6.92	1.00	56.2	17.9	
10/06/2009	16:57	6.45	0.60	115.5	11.0	

05-XDB, West Inlet to Dodge Pond, Route 10 Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	13:50			330.2	0.5	
03/16/2009	17:10		1.10	373.2	0.6	
03/27/2009	14:45		0.70	277.0	2.5	84
03/29/2009	12:50		0.90	210.9	1.4	61
04/03/2009	15:45		1.00	230.7	5.4	
07/30/2009	19:21	5.64	1.10	187.6	19.5	
10/06/2009	16:49			270.6		

02-LRT, Unnamed Tributary to Dodge Brook, Lovejoy Road, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	14:20		0.85	70.3	0.3
03/16/2009	17:35		0.95	60.5	0.2
03/27/2009	15:20		0.80	57.3	3.1
03/29/2009	12:10		1.20	48.1	1.4
04/03/2009	16:35		0.95	49.5	5.8
07/30/2009	19:53	5.18	1.00	36.8	19.5
10/06/2009	17:16	5.93	1.10	62.8	13.1

04-XDB, South Inlet to Dodge Pond, Boy Scout Camp Footbridge, Lempter

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/16/2009	16:40		0.60	49.7	1.5
03/27/2009	14:05		0.60	48.0	5.3
03/29/2009	13:05		0.70	39.0	3.1
04/03/2009	15:10		0.55	30.3	7.4
07/30/2009	19:11	4.53	0.65	32.8	18.5

03-XDB, East Inlet to Dodge Pond, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	13:25		0.50	102.1	0.6	
03/16/2009	16:50		0.40	87.8	0.3	
03/27/2009	14:10		0.80	75.9	1.9	18
03/29/2009	13:10		0.50	61.9	2.9	15
04/03/2009	15:15		0.70	64.7	6.1	
07/30/2009	19:04	4.81	0.80	54.1	18.4	
10/06/2009	16:35	5.56	0.65	78.1	11.1	

02-XDB, North Inlet to Dodge Pond, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	13:35		0.80	71.0	0.8	
03/16/2009	17:00		0.65	64.6	0.4	
03/27/2009	14:20		0.55	56.4	1.9	11
03/29/2009	13:00		0.60	51.3	0.8	11
04/03/2009	15:35		0.85	43.5	4.2	
07/30/2009	19:17	4.22	0.90	44.4	20.8	
10/06/2009	16:40	4.45	0.95	56.1	12.2	

01-XDB, Unnamed Tributary to Dodge Pond, Dodge Pond Beach, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/27/2009	14:40		0.95	51.4	1.4
03/29/2009	12:55		0.60	49.5	1.2
07/30/2009	18:59	5.67	1.20	87.0	21.1
08/19/2009	15:54	5.99	1.20	75.7	29.4
10/06/2009	16:46	5.93	2.10	97.2	15.3

07-DOB, Dodge Brook, Old Road Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	14:05		1.10	80.4	0.5	
03/16/2009	17:25		0.65	72.5	1.3	
03/27/2009	15:05		0.85	64.7	5.8	14
03/29/2009	12:30		1.10	56.4	3.0	14
04/03/2009	16:00		2.10	51.1	7.5	
07/30/2009	19:39	5.03	0.95	51.5	20.9	
08/19/2009	16:05	5.54	3.00	72.4	26.0	
10/06/2009	17:07	5.59	1.10	65.3	13.4	

02-CRT, Culter Road Tributary to Dodge Brook, Route 10 Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	14:15		1.00	80.1	0.6
03/16/2009	17:30		0.75	62.1	0.5
03/27/2009	15:15		0.60	42.1	4.0
03/29/2009	12:20		0.75	41.1	2.3
04/03/2009	16:15		0.95	34.2	7.0
07/30/2009	19:47	4.77	0.85	31.3	19.6
10/06/2009	17:12	5.70	0.75	52.0	11.9

05-DOB, Dodge Brook, Route 10 Bridge, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	14:30		0.80	77.1	0.4	
03/16/2009	17:40		0.60	64.5	1.4	
03/27/2009	15:30		0.80	55.9	5.1	12
03/29/2009	12:00		0.90	45.8	2.3	9.7
04/03/2009	16:45		0.95	44.0	6.9	
07/30/2009	19:59	5.14	1.00	40.0	20.0	
08/19/2009	16:10	6.01	1.70	83.0	22.6	
10/06/2009	17:21	5.89	1.00	66.7	11.5	

05-DOB-PIPE-1, D/S of Culvert on West Side of Rt 10 D/S of 05-DOB, Lempster

(Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.)

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/16/2009	17:45		28.00	219.5	1.0	
03/27/2009	15:35		9.30	105.2	4.2	28
03/29/2009	12:05		180.00	425.6	1.7	140
04/03/2009	16:55		15.00	115.4	4.3	

07/30/2009	20:05	5.19	1.10	40.5	20.1	

01-XJR, Unnamed Tributary to Dodge Brook, D/S of Jolly Roger Racetrack, Lempster

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/27/2009	15:45		2.50	19.9	4.2
03/29/2009	11:50		7.20	20.2	3.0
07/30/2009	20:10	5.54	0.95	18.6	17.3

01-DOB, Dodge Brook, East Acworth Road Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	13:00		0.90	74.4	0.7	
03/16/2009	16:20		1.20	54.8	0.3	
03/27/2009	16:20		0.55	45.8	3.9	8.5
03/29/2009	13:35		0.95	39.0	2.6	7.3
04/03/2009	14:30		0.75	39.8	6.0	
07/30/2009	18:25	5.64	1.30	33.6	20.6	
08/19/2009	15:16	6.55	1.10	81.1	22.1	
10/06/2009	16:06	6.57	1.00	64.6	11.8	

07-HNY, Honey Brook, Route 123A, Marlow

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	14:40		0.90	104.5	2.5	
03/16/2009	18:00		0.75	85.9	2.9	
03/27/2009	15:50		0.85	72.6	5.3	17
03/29/2009	11:45		1.10	56.6	3.4	11
04/07/2009	11:05		1.20	49.3	3.9	
07/30/2009	20:17	5.12	1.10	46.0	19.8	
10/06/2009	17:31	5.86	0.85	117.1	10.9	

01-HNY, Honey Brook, Route 123A Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	12:45		0.65	59.4	1.3	
03/16/2009	16:05		0.50	50.5	2.4	
03/27/2009	16:00		0.70	45.3	4.2	9.6
03/29/2009	13:40		0.90	39.8	2.6	7.1
04/07/2009	11:15		1.00	34.0	3.3	
07/30/2009	18:02	5.61	1.40	27.9	19.1	
08/19/2009	15:07	6.72	0.90	70.6	18.1	
10/06/2009	15:57	6.59	0.65	60.7	10.7	

01-XHB, Unnamed Tributary to Honey Brook, Acworth

Date	Time of Sample	Water Temp. (°C)	Specific Conductance (µS/cm)	Turbidity (NTUs)	Chloride (mg/L)
Standard	NA	Narrative	(µS/cm as chloride surrogate)	<10 NTU above backgrd	230[A]
03/16/2009	18:10	0.6	22.90	1.8	
03/27/2009	15:55	0.7	21.60	3.6	<5
04/07/2009	11:10	0.8	17.90	3.0	

07-CLD, Cold River, Grout Hill Road Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	12:30		1.00	56.5	0.7
03/16/2009	16:00		1.50	48.4	1.5
03/27/2009	16:25		1.00	43.7	4.8
03/29/2009	13:45		1.30	36.7	2.9
04/07/2009	11:30		1.20	35.9	3.6
07/30/2009	17:43	6.04	1.50	35.1	20.7
08/19/2009	14:59	6.90	1.20	62.1	24.3
10/06/2009	15:49	6.90	1.10	54.9	12.4

01-BOB, Bowers Brook, Route 123A Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	12:15		1.30	39.0	1.4	
03/16/2009	15:50		2.00	37.7	2.1	
03/27/2009	16:40		7.50	34.4	3.9	<5
03/29/2009	13:50		22.00	30.2	2.4	<5
04/07/2009	11:40		2.40	27.8	3.7	
07/30/2009	17:18	6.22	4.50	28.6	19.9	
08/19/2009	14:50	6.73	0.85	39.2	21.9	
10/06/2009	15:33	6.87	1.20	38.5	11.4	

06-CLD, Cold River, Route 123A Pulloff, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	12:10		0.95	54.6	0.5
03/16/2009	15:40		2.10	49.0	0.9
03/29/2009	13:55		5.90	37.8	3.1
04/07/2009	11:45		1.90	36.8	3.7
07/30/2009	17:09	6.21	2.70	34.9	20.3
10/06/2009	15:26	7.21	0.95	56.1	12.0

01-MIB, Milliken Brook, Route 13A Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	12:00		1.10	50.1	1.0
03/16/2009	15:30		2.70	46.3	2.5
03/27/2009	16:45		11.00	41.5	4.3
03/29/2009	14:05		2.20	36.8	3.0
04/07/2009	11:55		8.10	37.4	3.9
07/30/2009	17:03	6.63	3.60	41.2	19.8
08/19/2009	14:45	6.84	0.65	57.6	21.4

10/06/2009	15:14	7.47	0.55	60.1	11.5

09-THB, Thayer Brook, Newell Pond Road Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	20:35	6.34	0.85	30.4	25.0
08/19/2009	17:40	6.80	0.85	26.3	29.1
10/06/2009	17:47	6.29	0.70	26.9	15.3

02-THB, Thayer Brook, Forrest Road Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	11:45		1.10	34.4	1.0
03/16/2009	15:20		0.80	29.8	2.4
07/30/2009	16:50	6.31	2.40	25.6	19.3
08/19/2009	14:35	6.71	0.65	42.4	19.6
10/06/2009	14:41	6.84	0.55	40.0	10.9

05A-CLD, Cold River, Forrest Road Bridge, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/16/2009	15:12		2.00	48.0	1.3	
03/27/2009	16:50		4.50	43.4	5.3	
03/29/2009	14:10		11.00	36.4	3.3	5.4
04/07/2009	12:00		3.50	36.5	3.8	
07/30/2009	16:54	6.29	3.50	35.0	20.5	
08/19/2009	14:20	7.03	0.70	65.5	24.1	
10/06/2009	14:32	6.85	1.00	58.0	12.3	

01-CAM, Unnamed Tributary to the Cold River,Campbell Road, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
04/07/2009	12:05		4.50	39.3	4.2
07/30/2009	16:35	6.73	6.90	57.8	18.6
08/19/2009	14:15	6.83	2.80	65.0	22.2
10/06/2009	14:23	6.97	1.10	63.6	12.7

06-CRB, Crane Brook, Crane Brook Road, Acworth

Date	Time of Sample	Water Temp. (°C)	Specific Conductance (µS/cm)	*E. coli* (CTS/100mL)	Total Phosphorus (mg/L)	TKN (mg/L)	Ammonia (mg/L)	N02+N03 (mg/L)
Standard	NA	Narrative	(µS/cm as chloride surrogate)	<406	Narrative	Narrative	Narrative	Narrative
09/16/2009	13:35	13.80	39.4	10	0.011	0.31	ND	0.22

05C-CRB, Crane Brook, Bascom Hill Road, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
08/19/2009	14:00	6.81	1.00	68.0	20.5
09/16/2009	11:20			61.9	13.4
10/06/2009	13:23	6.79	0.85	50.3	11.6

03-XCB, Bascom Hill Road Trib, Upstream of Wetlands, Acworth

Date	Time of Sample	N02+N03	Total Phosphorus (mg/L)	TKN (mg/L)	Ammonia (mg/L)	*E. coli* (CTS/100mL)
Standard	NA	Narrative	Narrative	Narrative	Narrative	<406
9/16/2009		0.35	0.04	0.30	ND	40

01-XCB, Bascom Hill Road Tributary, Bascom Hill Road

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	N02+N03 (mg/L)	TKN (mg/L)	NH_3 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	<406	Narrative	Narrative	Narrative	Narrative
07/30/2009	14:38	7.03	3.80	126.9	18.4					
08/19/2009	14:05	7.25	1.30	207.1	21.0					
09/16/2009						30	0.49	0.36	ND	0.076
10/06/2009	13:36	7.14	1.00	200.8	11.6					

05-CRB, Crane Brook, Crane Brook - D/S of Confluence w/ Bascom Hill Road Tirb, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	*E. coli* (CTS/100mL)	N02+N03 (mg/L)	TKN (mg/L)	NH_3 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	<406	Narrative	Narrative	Narrative	Narrative
07/30/2009	14:33	6.42	3.00	40.7	19.8					
09/16/2009						<10	0.066	0.26	ND	0.025
10/06/2009	13:30	6.77	0.80	76.4	11.4					

01-XCA, Unnamed Tributary to Crane Brook, Alstead

Date	Time of Sample	pH	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	(µS/cm as chloride surrogate)	Narrative
10/06/2009	14:03	7.29	143.31	11.2

04-CRB, Crane Brook, Downstream of Unnamed Tributary, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
10/06/2009	14:06	7.29	1.10	85.3	11.2

01-CRB, Crane Brook, Upstream of Confluence with Cold River, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/07/2009	11:30		1.20	82.6	1.7
03/16/2009	15:05		3.30	75.0	4.1
04/07/2009	12:25		3.80	64.1	4.4
07/30/2009	14:14	6.77	5.40	61.2	19.5
08/19/2009	13:45	7.07	0.60	79.8	21.9
10/06/2009	13:10	7.09	0.65	81.9	12.3

04M-CLD, Cold River, McDermott Bridge, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/29/2009	14:20		10.00	38.4	3.4
04/07/2009	12:20		4.40	38.0	3.9
07/30/2009	13:56	6.25	5.60	35.2	20.1
08/19/2009	13:40	7.11	0.90	65.9	24.5
10/06/2009	12:36	6.94	1.30	60.2	12.1

01-XVP, Unnamed Tributary to Vilas Pool, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
03/16/2009	15:00		1.10	29.8	3.5
03/27/2009	17:00		1.00	29.6	5.9
03/29/2009	14:25		1.90	31.5	4.2
04/07/2009	12:30		0.80	30.2	4.6
07/30/2009	13:47	6.42	4.10	34.8	17.9
08/19/2009	13:20	6.93	0.80	58.3	20.8

12-WAB, Warren Brook, Prentice Hall Road Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
04/07/2009	10:50		1.50	48.5	5.1
07/30/2009	12:26	6.24	2.30	51.6	24.4
08/19/2009	11:45	6.38	1.10	45.4	27.5
10/06/2009	11:29	6.49	2.00	45.9	14.4
10/07/2009	10:35		1.60	44.4	13.7
10/20/2009	06:35		1.70	41.5	8.8

09-WAB, Warren Brook, 2nd Crossing of Route 123 D/S of Warren Lake Dam, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	12:49	6.42	3.80	51.0	24.1
08/19/2009	12:06	6.40	0.70	53.4	24.7
10/07/2009	10:40		2.80	46.4	13.2
10/20/2009	06:40		1.80	41.8	8.7

07-WAB, Warren Brook, Route 123 Bridge at Town Barn, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	12:59	6.54	5.20	48.4	23.6
08/19/2009	12:30	6.61	0.70	52.1	22.5
10/06/2009	11:38	6.66	1.10	48.7	13.1
10/07/2009	10:45		3.50	46.7	12.6
10/20/2009	06:50		1.70	40.7	8.7

03-CAB, Camp Brook, Camp Brook Road Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/29/2009	11:20		2.90	39.8	3.4	7
04/03/2009	12:35		0.85	39.1	6.5	
04/07/2009	10:45		1.30	43.3		
07/30/2009	12:15	5.58	3.20	31.8	20.2	
08/19/2009	11:35	5.01	5.10	65.7	23.0	
10/06/2009	11:13	6.10	1.20	58.1	11.4	
10/07/2009	10:15		2.50	56.6	11.2	
10/20/2009	06:20		1.80	39.7	7.9	

05-WAB, Warren Brook, Site of Former Cooper Hill Road Culvert, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	13:15	6.14	6.20	46.3	22.8
08/19/2009	12:40	6.31	2.20	67.8	24.2
10/06/2009	11:50	6.33	1.60	59.7	12.5
10/07/2009	10:50		4.30	64.4	12.0
10/20/2009	07:00		3.10	44.9	8.6

03-WAB, Warren Brook, Route 123 Upstream of Junction with Route 12A, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	13:28	6.39	17.00	46.5	22.6
08/19/2009	12:50	6.73	1.70	77.8	25.8
10/06/2009	12:00	6.58	1.80	68.3	13.9
10/07/2009	10:55		6.90	68.0	12.3
10/20/2009	07:10		3.30	46.3	8.6

01-WAB, Warren Brook, Route 123A Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]
03/07/2009	15:00		3.70	67.7	3.0	
03/16/2009	14:30		41.00	64.0	5.2	
03/27/2009	17:05		4.80	56.8	7.0	9.5
03/29/2009	14:30		2.00	52.3	4.4	8.4
04/07/2009	12:55		4.50	50.6	4.8	
07/30/2009	13:39	6.51	19.00	47.9	22.7	
08/19/2009	13:10	7.17	1.60	84.9	26.3	
10/06/2009	12:08	6.87	1.40	73.0	13.9	
10/07/2009	11:00		7.10	69.8	12.8	
10/20/2009	07:20		4.20	48.3	8.7	

03-CLD, Cold River, Route 123 Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
04/07/2009	13:05		4.10	40.9	4.2
07/30/2009	11:05	6.50	9.80	38.1	20.0
08/19/2009	10:53	7.34	0.85	71.2	23.6
10/06/2009	10:43	6.91	1.20	65.5	12.1
10/07/2009	11:15		2.30	62.1	12.2
10/20/2009	07:25		2.60	42.4	8.1

01-DAB, Darby Brook, Comstock Road Bridge, Alstead

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	11:45	6.49	5.90	42.2	19.3
08/19/2009	11:10	6.93	1.20	85.9	18.8
10/06/2009	10:55	6.95	0.90	70.4	10.9

02-CLD, Cold River, Drewsville, Route 13 Bridge, Walpole

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
04/07/2009	13:10		4.40	42.3	4.4
07/30/2009	08:38	6.60	14.00	39.7	19.6
08/19/2009	09:12	6.87	1.40	77.1	22.4
10/06/2009	08:46	6.88	0.85	68.6	11.0
10/07/2009	11:55		2.10	64.3	13.2

02-CLD PIPE, Drewsville, Route 123 Bridge, Walpole

(Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.)

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**
04/07/2009	13:15		1.50	97.7	7.1
07/30/2009	08:45	6.81	8.20	127.2	16.7
10/07/2009	12:00		6.60	112.5	12.3

01-LBK, Little Brook, Ball Hill Road, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	TKN (mg/L)	NO2+NO3 (mg/L)	Total Phosphorus (mg/L)
Standard	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**	**230[A]**	**Narrative**	**Narrative**	**Narrative**
07/30/2009	10:36	6.74	2.20	76.5	19.7				
09/29/2009	12:40			116.0	15.4	8.4	0.37	ND	0.037

01-XLB, Unnamed Tributary to Little Brook, Ball Hill Road, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	NO2+NO3 (mg/L)	Total Phosphorus (mg/L)
Standard	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**	**230[A]**	**Narrative**	**Narrative**
07/30/2009	10:46	6.89	2.20	282.6	21.5			
08/19/2009	10:40	7.11	7.30	427.7	21.9			
09/29/2009	12:55			448.8	14.3	75	0.52	0.540
10/06/2009	10:06			452.2	12.2			

03A-GRB, Great Brook, 100' Upstream from Little Brook, Acworth

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative
07/30/2009	10:52	6.96	3.40	56.7	18.8			
09/29/2009	12:45			64.3	13.3	2.5	ND	0.008

02-XGB, Unnamed Tributary to Great Brook, Route 12A, Acworth

Date	Time of Sample	pH	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	(µS/cm as chloride surrogate)	Narrative
09/29/2009	13:05		159.00	13.7
10/06/2009	10:13	6.51	162.53	11.1

03-GRB, Great Brook, Route 12A Bridge at Ball Hill Road, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
07/30/2009	10:26	6.34	3.30	56.5	18.9
08/19/2009	10:36	6.86	0.95	67.0	19.6
09/29/2009	12:30			66.8	13.4
10/06/2009	09:58	6.74	1.10	66.9	10.5
10/07/2009	11:25		2.60	60.0	11.3

02-GRB, Great Brook, Covered Bridge on Cheshire Turnpike, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative
07/30/2009	09:00	6.94	4.20	58.1	16.8			
08/19/2009	09:37	6.74	0.70	68.9	18.9			
09/29/2009	11:10			70.3	13.5	5.3	0.07	0.005
10/06/2009	09:02	6.75	0.60	69.8	10.4			
10/07/2009	11:50		3.10	61.3	11.9			

07-RAB, Ram Brook, Route 12 Downstream Side of Culvert, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative
04/07/2009	13:40		2.90	87.0	4.7
07/30/2009	09:50	7.04	1.70	107.4	19.4
08/19/2009	10:26	7.29	3.20	101.3	21.3

03-RAB, Ram Brook, Jewett Road, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	TKN (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative	Narrative
03/30/2009	18:15		0.95	122.2	6.8	12			
04/03/2009	12:55		0.85	122.6	9.3				
04/07/2009	13:25		1.10	120.8	6.8				
07/30/2009	09:10	6.20	3.80	138.5	14.0				
08/19/2009	09:48	6.23	2.60	152.2	13.5				
09/29/2009	11:30			146.0	11.2	17	1.7	ND	0.053
10/06/2009	09:32	6.34		145.8	10.3				

07-BMB Brush Meadow Brook, Brush Meadow Brook at FMRHS Entrance, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	TKN (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative	Narrative
03/30/2009	18:10		1.10	129.8	3.7	25			
04/03/2009	13:05		1.20	105.7	7.3				
04/07/2009	13:35		1.30	97.9	4.1				
07/30/2009	09:39	6.10	3.00	112.1	22.4				
08/19/2009	10:11	6.12	7.00	125.0	25.8				
09/29/2009	11:45			146.0	15.5	28	0.78	ND	0.090
10/06/2009	09:42	6.27	9.10	228.4	12.0				
10/07/2009	11:35		6.10	179.5	12.8				

03-BMB Brush Meadow Brook, Jewett Rd, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	TKN (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative	Narrative
03/30/2009	18:20		4.70	124.2	4.8				
04/03/2009	13:00		1.40	114.8	8.1				
04/07/2009	13:30		3.60	114.7	5.3				
07/30/2009	09:25	6.57	3.30	171.0	19.5				
08/19/2009	09:59	6.62	2.40	143.1	17.6				
09/29/2009	11:30			185.5	12.9	13	0.38	1.3	0.043
10/06/2009	09:19	6.76	2.80	164.2	9.7				
10/07/2009	11:40		3.90	160.7	11.6				

01-JEB, Jewett Brook, 50' Upstream of Confluence with Great Brook, Langdon

Date	Time of Sample	Water Temp. (°C)	Specific Conductance (µS/cm)	Total Phosphorus (mg/L)	N02+N03 (mg/L)	Chloride (mg/L)
Standard	NA	Narrative	(µS/cm as chloride surrogate)	Narrative	Narrative	230[A]
09/29/2009	14:00	11.90	56.6	0.010	ND	<5

01P-GRB, Great Brook, 50 Feet Downstream of Jewett Brook, Langdon

Date	Time of Sample	Specific Conductance (µS/cm)
Standard	NA	
09/29/2009	14:00	81.1

01-GRB, Great Brook, Cold River Road Bridge, Langdon

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)	Chloride (mg/L)	N02+N03 (mg/L)	Total Phosphorus (mg/L)
Standard	NA	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	Narrative	230[A]	Narrative	Narrative
04/07/2009	13:20		2.90	50.1	4.7			
07/30/2009	08:20	6.96	5.30	62.1	19.0			
08/19/2009	09:05	6.89	0.80	81.3	19.2			
09/29/2009	10:50			85.2	13.2	6.8	0.22	0.006
10/06/2009	08:21	6.98	0.85	82.1	10.0			
10/07/2009	12:10		1.80	72.9	12.0			

01-MTB, Mountain Brook, Cold River Road Bridge, Walpole

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**
07/30/2009	08:07	6.23	3.70	18.1	19.7
08/19/2009	09:18	6.85	1.10	38.8	19.2
10/06/2009	07:58	6.86	0.90	40.8	9.0

01-CLD, Cold River, Arch Bridge, Walpole

Date	Time of Sample	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	**NA**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**
07/30/2009	07:52	6.36	18.00	41.3	19.8
08/19/2009	08:35	6.94	0.75	85.3	21.0
10/06/2009	06:53	6.88	0.85	75.1	10.4
10/07/2009	12:15		1.80	71.8	12.5

00H-CLD, Cold River, Route 12 Bridge, Walpole

Date	Time of Sample	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (µS/cm)	Water Temp. (°C)
Standard	**NA**	**>75% Daily Average**	**6.5-8.0**	**<10 NTU above backgrd**	**(µS/cm as chloride surrogate)**	**Narrative**
08/22/2009	11:23	115.5	7.04	2.2	60.5	21.2

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 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 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 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.

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2008

APPENDIX C:

2009 VRAP 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 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 audit, VRAP staff offer important reminders and suggestions to ensure proper sampling techniques and re-trained volunteers in the areas needing improvement. It is important to ensure that all volunteers attend an annual VRAP training workshop prior to the sampling season to familiarize themselves with proper sampling techniques. Please remember to schedule an annual field audit in 2010.