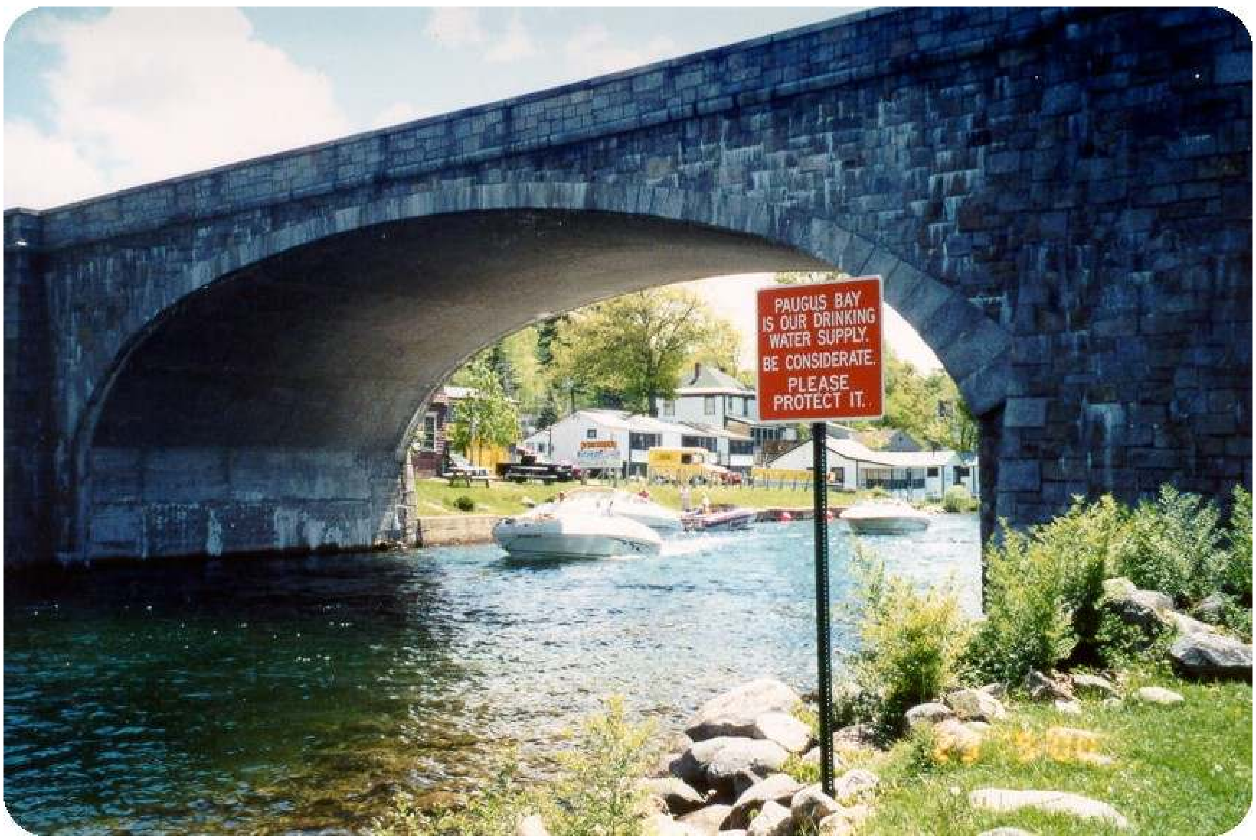
New Hampshire Volunteer River Assessment Program
2009 Lake Winnipesaukee Tributaries
Water Quality Report



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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New Hampshire Volunteer River Assessment Program 2009 Lake Winnipesaukee Tributaries Water Quality Report

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ACKNOWLEDGEMENTS

The New Hampshire Department of Environmental Services Volunteer River Assessment Program extends sincere thanks to the volunteers of the Lake Winnipesaukee Watershed Association, Laconia Conservation Commission, and the Wolfeboro Conservation Commission for their efforts during 2009. This report was created solely from the data collected by the volunteers listed below. Their time and dedication is an expression of their genuine concern for local water resources and has significantly contributed to our knowledge of river and stream water quality in New Hampshire.

2009 Lake Winnipesaukee Tributaries Volunteers

Dean Anson

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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 is unusable for assessment purposes due to quality control requirements.

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

  This appendix provides a brief description of water quality parameters typically sampled by VRAP volunteers, 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 (see Appendix C). If necessary, volunteers are re-trained during the visit, and the group's monitoring coordinator is notified of the result of the verification visit. VRAP groups forward water quality results to NHDES for incorporation into an annual report and state water quality assessment activities.

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 (QA/QC) measures include a six-step approach to ensuring the accuracy of the equipment and consistency in sampling efforts.

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

2.7.1 Measurement Performance Criteria

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

(Equation 1. Relative Percent Difference)

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

Where x_1 is the original sample and x_2 is the replicate sample.

Table 1. Field Analytical Quality Controls

Water Quality Parameter	QC Check	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Temperature	Measurement Replicate	RPD < 10% or Absolute Difference <0.8 C.	Repeat Measurement	Volunteer Monitors	Precision
Dissolved Oxygen	Measurement Replicate	RPD < 10%	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (Zero O_2 Sol.)	RPD < 10% or Absolute Difference <0.4 mg/L	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Relative Accuracy
pH	Measurement Replicate	Absolute Difference <0.3 pH units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Known Buffer (pH = 6.0)	± 0.1 std units	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Specific Conductance	Measurement Replicate	RPD < 10% or Absolute Difference <5µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (Zero Air Reading)	± 5.0 µS/cm	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Turbidity	Measurement Replicate	RPD < 10% or Absolute Difference <1.0 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Precision
	Method Blank (DI Water)	± 0.1 NTU	Recalibrate Instrument, Repeat Measurement	Volunteer Monitors	Accuracy
Laboratory Parameters	Measurement Replicate	RPD < 20% or Absolute Difference less than ½ the mean value of the parameter in NHDES's Environmental Monitoring Database	Repeat Measurement	Volunteer Monitors	Precision

3.0 METHODS

During the summer of 2004, volunteers from the Lake Winnipesaukee Watershed Association began water quality monitoring on the tributaries feeding into Lake Winnipesaukee. The goal of this effort was to provide water quality data from the Lake Winnipesaukee tributaries 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.

During 2009, volunteers from the Lake Winnipesaukee Watershed Assocation, Laconia Conservation Commission, and the Wolfeboro Conservation Commission monitored water quality at 16 stations in the Lake Winnipesakuee watershed including stations on Black Brook and the Gunstock River in Gilford, tributaries to Paugus Bay in Laconia, and the Smith River in Wolfeboro (Table 2). NHDES Stations IDs are typically 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. However, at this time, NHDES has used the existing station IDs provided by the Laconia Conservation Commission. All stations monitored in 2009 are designated as Class B waters. This classification is used to apply the appropriate water quality standard.

The establishment of a long-term monitoring program will allow for an understanding of the river's dynamics, or variations on a station-by-station and year-to-year basis. The data can also serve as a baseline from which to determine any water pollution problems in the river and/or watershed. The Volunteer River Assessment Program has provided field training, equipment, and technical assistance.

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

Table 2. Sampling Stations for the Lake Winnipesaukee Tributaries, NHDES VRAP, 2009

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation *(Rounded to the Nearest 100 Feet)*
BB1 No AUID at 1 to 100,000	**B**	**Black Brook**	Black Brook 1	Gilford	500
01-XSB No AUID at 1 to 100,000	**B**	**Unknown Tributary to Sanders Bay**	Unknown Tributary to Sanders Bay on Rt 11	Gilford	500
02-AHB No AUID at 1 to 100,000	**B**	**Adder Hole Brook**	Upstream	Gilford	500
01-AHB No AUID at 1 to 100,000	**B**	**Adder Hole Brook**	Downstream/Sanders Bay	Gilford	500
12-GSK NHRIV700020107-04	**B**	**Gunstock River**	Hoyt Road	Gilford	500
06-GSK NHRIV70020107-04	**B**	**Gunstock River**	Intervale Road	Alton	500
04-GSK NHRIV700020107-04	**B**	**Gunstock River**	Old Lake Shore Road	Gilford	500
OUT-001 No AUID	**N/A**	**N/A**	Outfall Pipe at End of Mass Ave	Laconia	500
TRIB-011 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Golf Course Tributary at Paugus Park Road & North Street Intersection	Laconia	500
TRIB-013A No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Upstream of Outerbridge Drive	Laconia	500
TRIB-014 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Tributary Outlet to Paugus Bay Through South Down	Laconia	500
TRIB-016 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	State Forest	Laconia	500
TRIB-018 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Pickerel Cove, Upstream	Laconia	500
TRIB-019 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Pickerel Cove, Downstream	Laconia	500
TRIB-21 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Black Brook at Gilford Plaza	Laconia	500
TRIB-22 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Black Brook at Union Ave	Laconia	500
TRIB-24 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Langley Brook	Laconia	500
TRIB-25 No AUID at 1 to 100,000	**B**	**Tributary to Paugus Bay**	Unnamed Tributary to Moultons Cove	Laconia	500
03-SRW NHRIV700020101-19	**B**	**Smith River**	Crescent Lake Outlet	Wolfeboro	500
01-SRW NHRIV700020101-21	**B**	**Smith River**	Back Bay Outlet	Wolfeboro	500

Table 3. Sampling and Analysis Methods

Parameter	Sample Type	Standard Method	Equipment Used	Laboratory
Temperature	In-Situ	SM 2550	YSI 85	------
Dissolved Oxygen	In-Situ	SM 4500 O G	YSI 85	------
pH	In-Situ	SM 4500 H+	Oakton pH 11	------
Turbidity	In-Situ	EPA 180.1	YSI 85	------
Specific Conductance	In-Situ	SM 2510	LaMotte 2020e	------
Total Phosphorus	Bottle (w/ Preservative)	EPA 365.3	------	NHDES
Nitrate+Nitrite	Bottle	EPA 353.2	------	NHDES
Chloride	Bottle	SM D512C	------	NHDES Limnology Center

4.0 RESULTS AND RECOMMENDATIONS

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

4.1 Dissolved Oxygen

Between one and seven measurements were taken in the field for dissolved oxygen concentration at 20 stations in the Lake Winnipesaukee watershed (Table 4). Of the 89 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

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

Two stations (01-XSB and TRIB-018) had at least one measurement taken for dissolved oxygen concentration that was below the New Hampshire Class B surface water quality standard (Figure 1). All other stations were above the standard on all occasions. The average concentration of dissolved oxygen ranged from 3.39 mg/L to 10.16 mg/L. Levels of dissolved oxygen sustained above the standards are considered adequate for the support of aquatic life and other desirable water quality conditions.

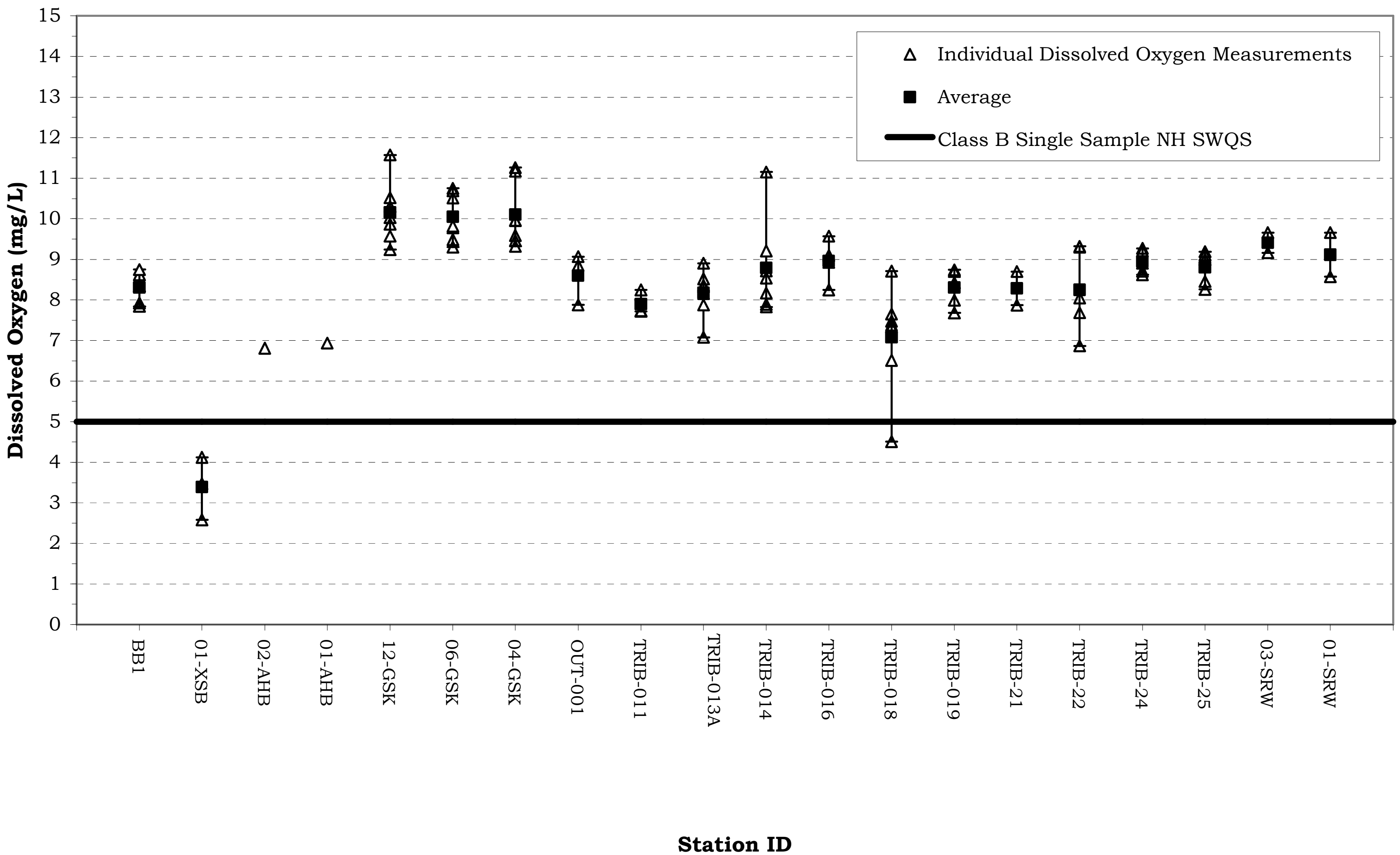
Stations where the instantaneous dissolved oxygen standard was not met could potentially have a dissolved oxygen problem and further investigation is warranted. It should be noted however, that low dissolved oxygen levels may be the result of natural conditions (e.g., the presence of wetlands or stagnant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

Table 4. Dissolved Oxygen (mg/L) Summary – Lake Winnipesaukee Tributaries, 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
BB1	6	7.84 - 8.75	0	6
01-XSB	3	2.58 - 4.12	3	3
02-AHB	1	6.81	0	1
01-AHB	1	6.94	0	1
12-GSK	7	9.24 - 11.57	0	7
06-GSK	7	9.30 - 10.75	0	7
04-GSK	7	9.32 - 11.26	0	7
OUT-001	3	7.88 - 9.07	0[A]	3
TRIB-011	3	7.72 - 8.25	0	3
TRIB-013A	7	7.08 - 8.90	0	7
TRIB-014	7	7.83 - 11.15	0	7
TRIB-016	4	8.25 - 9.57	0	4
TRIB-018	7	4.51 - 8.71	1	7
TRIB-019	5	7.68 - 8.74	0	5
TRIB-21	2	7.87 - 8.70	0	2
TRIB-22	5	6.87 - 9.32	0	5
TRIB-24	5	8.62 - 9.27	0	5
TRIB-25	5	8.26 - 9.19	0	5
03-SRW	2	9.16 - 9.66	0	2
01-SRW	2	8.57 - 9.66	0	2
Total	**89**	_____	**4**	**89**

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

Figure 1. Dissolved Oxygen Statistics for the Lake Winnipesaukee Tributaries
June 22 - September 8, 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.

- If possible, take measurements between 5 a.m. and 10 a.m., which is when dissolved oxygen is usually the lowest, and between 2 p.m. and 7 p.m. when dissolved oxygen is usually the highest. In general, dissolved oxygen levels are lowest in the early morning when there is low photosynthetic activity and a peak in respiration from organisms throughout the water column. This is the time of least oxygen production and greatest carbon dioxide emission. Peak dissolved oxygen levels occur when photosynthetic activity is at its peak. The greater the amount of photosynthetic activity the greater the production of oxygen as a byproduct of photosynthesis.

- Consider incorporating the use of in-situ dataloggers to automatically record dissolved oxygen saturation levels during a period of several days. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

4.2 pH

Between one and seven measurements were taken in the field for pH at 20 stations in the Lake Winnipesaukee watershed (Table 5). Of the 89 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.

All but four stations had one or more pH measurements that were below the New Hampshire Class B surface water quality standard minimum (Figure 2).

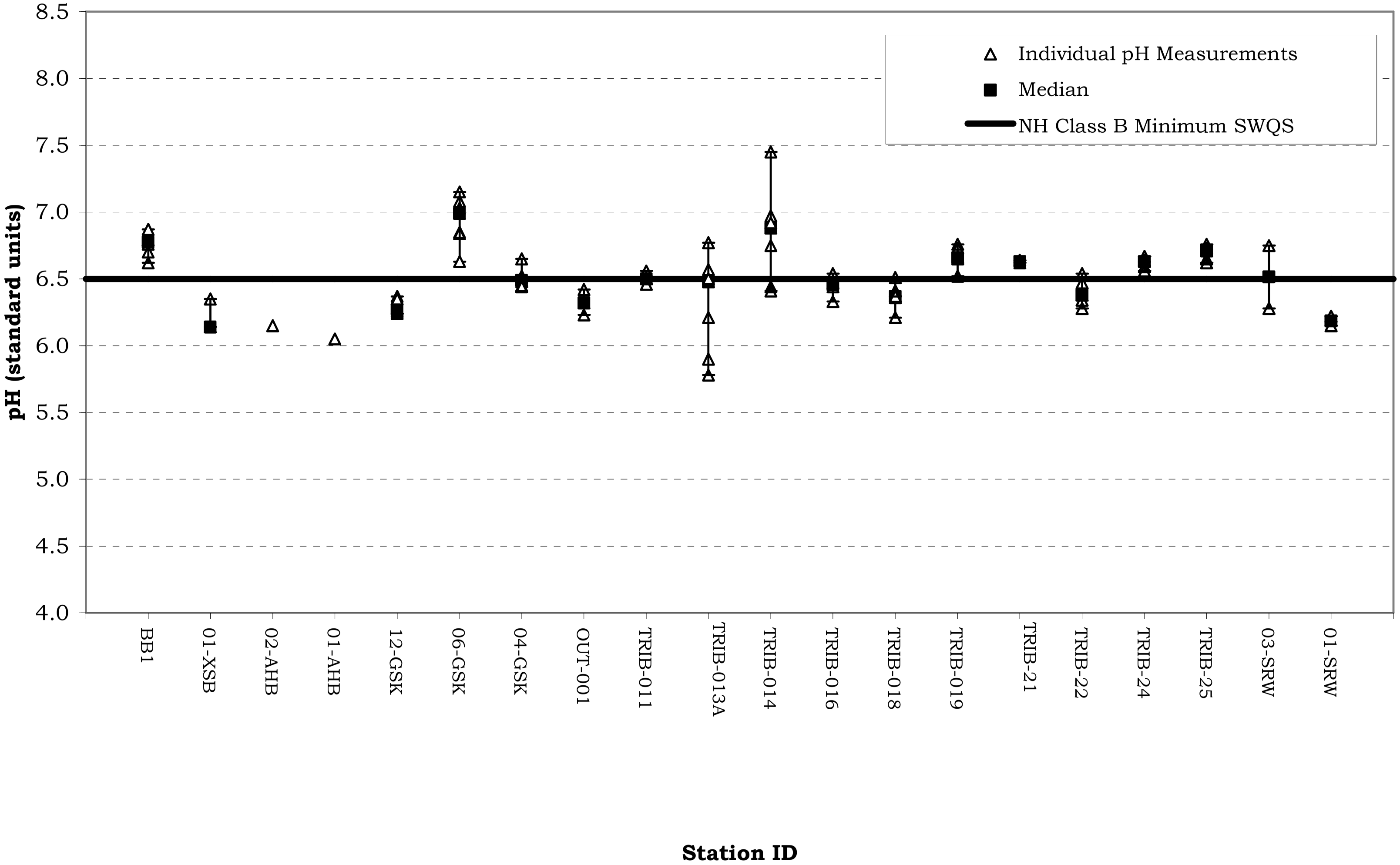
Lower pH measurements are likely the result of natural conditions such as the soils, geology, or the presence of wetlands in the area. Rain and snow falling in New Hampshire is relatively acidic, which can also affect pH levels; after the spring melt or significant rain events, surface waters will generally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

Table 5. pH Data Summary - Lake Winnipesaukee Tributaries, 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
BB1	6	6.62 - 6.87	0	6
01-XSB	3	6.14 - 6.35	3	3
02-AHB	1	6.15	1	1
01-AHB	1	6.05	1	1
12-GSK	7	6.24 - 6.37	7	7
06-GSK	7	6.63 - 7.15	0	7
04-GSK	7	6.44 - 6.65	4	7
OUT-001	3	6.23 - 6.42	0[A]	3
TRIB-011	3	6.46 - 6.56	1	3
TRIB-013A	7	5.78 - 6.77	4	7
TRIB-014	7	6.41 - 7.45	2	7
TRIB-016	4	6.33 - 6.54	3	4
TRIB-018	7	6.21 - 6.51	6	7
TRIB-019	5	6.52 - 6.76	0	5
TRIB-21	2	6.62 - 6.64	1	2
TRIB-22	5	6.28 - 6.54	4	5
TRIB-24	5	6.56 - 6.67	5	5
TRIB-25	5	6.62 - 6.76	0	5
03-SRW	2	6.28 - 6.75	1	2
01-SRW	2	6.15 - 6.22	2	2
Total	**89**	_____	**45**	**89**

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

Figure 2. pH Statistics for the Lake Winnipesaukee Tributaries
June 22 - September 8, 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.

- Consider sampling for pH in some of the tributaries and wetland areas that are influencing the pH of stations with measurements below state standards. Wetlands can lower the pH of a river naturally by releasing tannic and humic acids from decaying plant material. If the sampling location is influenced by wetlands or other natural conditions, then the low pH measurements are not considered a violation of water quality standards. It is important to note that the New Hampshire water quality standard for pH is fairly conservative, thus pH levels slightly below the standard are not necessarily harmful to aquatic life. In this case, additional information about factors influencing pH levels is needed.

4.3 Turbidity

Between one and seven measurements were taken in the field for turbidity at 20 stations in the Lake Winnipesaukee watershed [Table 6]. Of the 87 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

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

Turbidity levels were relatively low with the average ranging from 0.11 NTU to 12.84 NTU (Figure 3).

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.

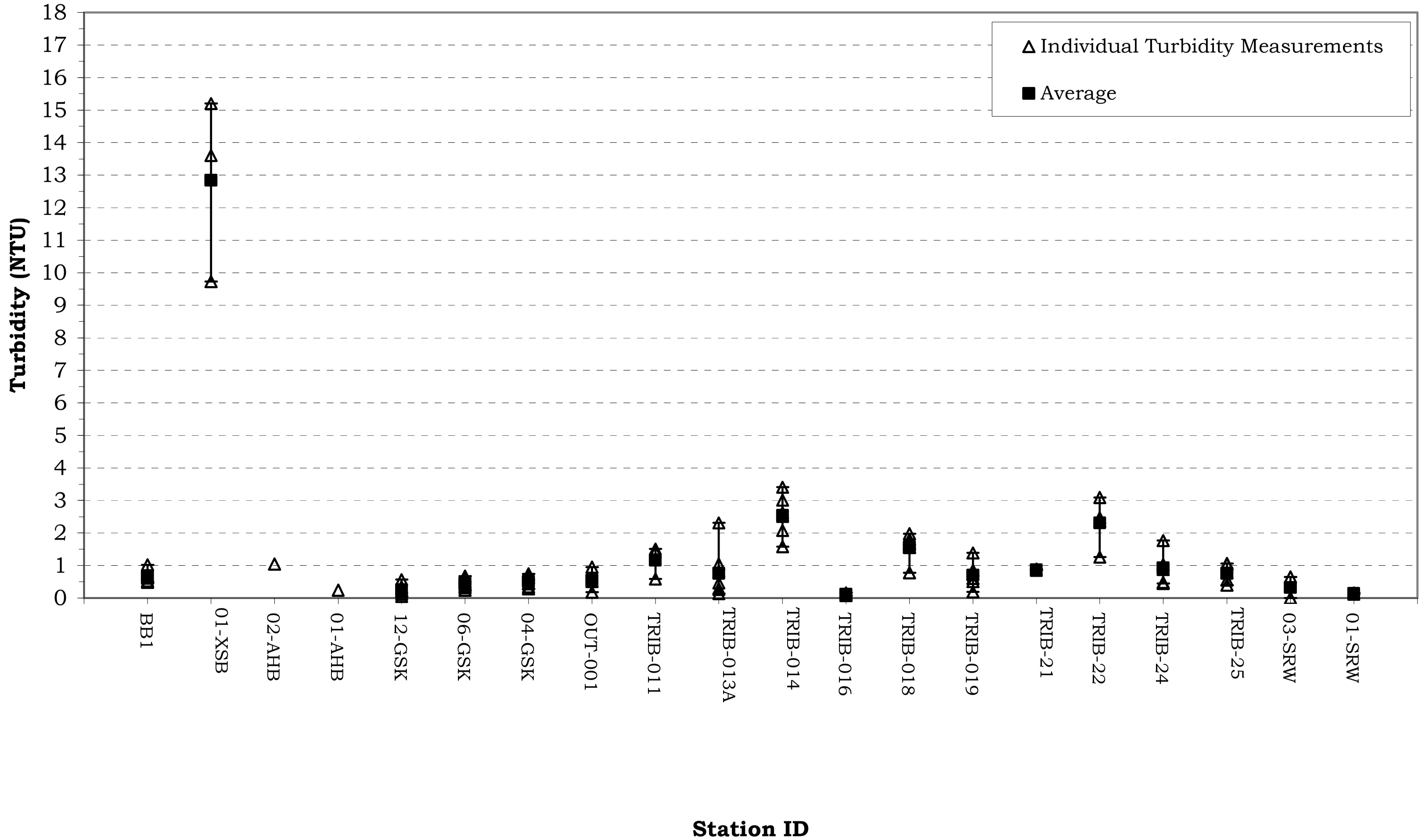
- If a higher than normal turbidity measurement occurs, volunteers can investigate further by moving upstream and taking additional measurements. This will facilitate isolating the location of the cause of the elevated turbidity levels. In addition, take good field notes and photographs. If human activity is suspected or verified as the source of elevated turbidity levels, volunteers should contact NHDES.

Table 6. Turbidity Data Summary - Lake Winnipesaukee Tributaries, 2009

Station ID	Samples Collected	Data Range (NTU)	Acceptable Samples Not Meeting NH Class B Standards	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
BB1	6	0.48 - 1.02	0	6
01-XSB	3	9.73 - 15.2	0	3
02-AHB	1	1.05	0	1
01-AHB	1	0.24	0	1
12-GSK	1	0.57	0	1
06-GSK	7	0.24 - 0.67	0	7
04-GSK	7	0.28 - 0.75	0	7
OUT-001	7	0.18 - 0.95	0[A]	7
TRIB-011	3	0.58 - 1.51	0	3
TRIB-013A	7	0.14 - 2.31	0	7
TRIB-014	7	1.58 - 3.41	0	7
TRIB-016	4	0.07 - 0.16	0	4
TRIB-018	7	0.78 - 1.98	0	7
TRIB-019	5	0.19 - 1.39	0	5
TRIB-21	2	0.85 - 0.89	0	2
TRIB-22	5	1.26 - 3.09	0	5
TRIB-24	5	0.45 - 1.77	0	5
TRIB-25	5	0.4 - 1.06	0	5
03-SRW	2	0.00 - 0.65	0	2
01-SRW	2	0.12 - 0.16	0	2
Total	**87**	_____	**0**	**87**

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

Figure 3. Turbidity Statistics for the Lake Winnipesaukee Tributaries
June 22 - September 8, 2009, NHDES VRAP



4.4 Specific Conductance

Between one and seven measurements were taken in the field for specific conductance at 20 stations in the Lake Winnipesaukee watershed (Table 7). Of the 87 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.

Specific conductance levels were variable throughout the watershed with the average ranging from 53 μS/cm to 921 μS/cm (Figure 4). 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.

Recommendations

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

- Continue 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.

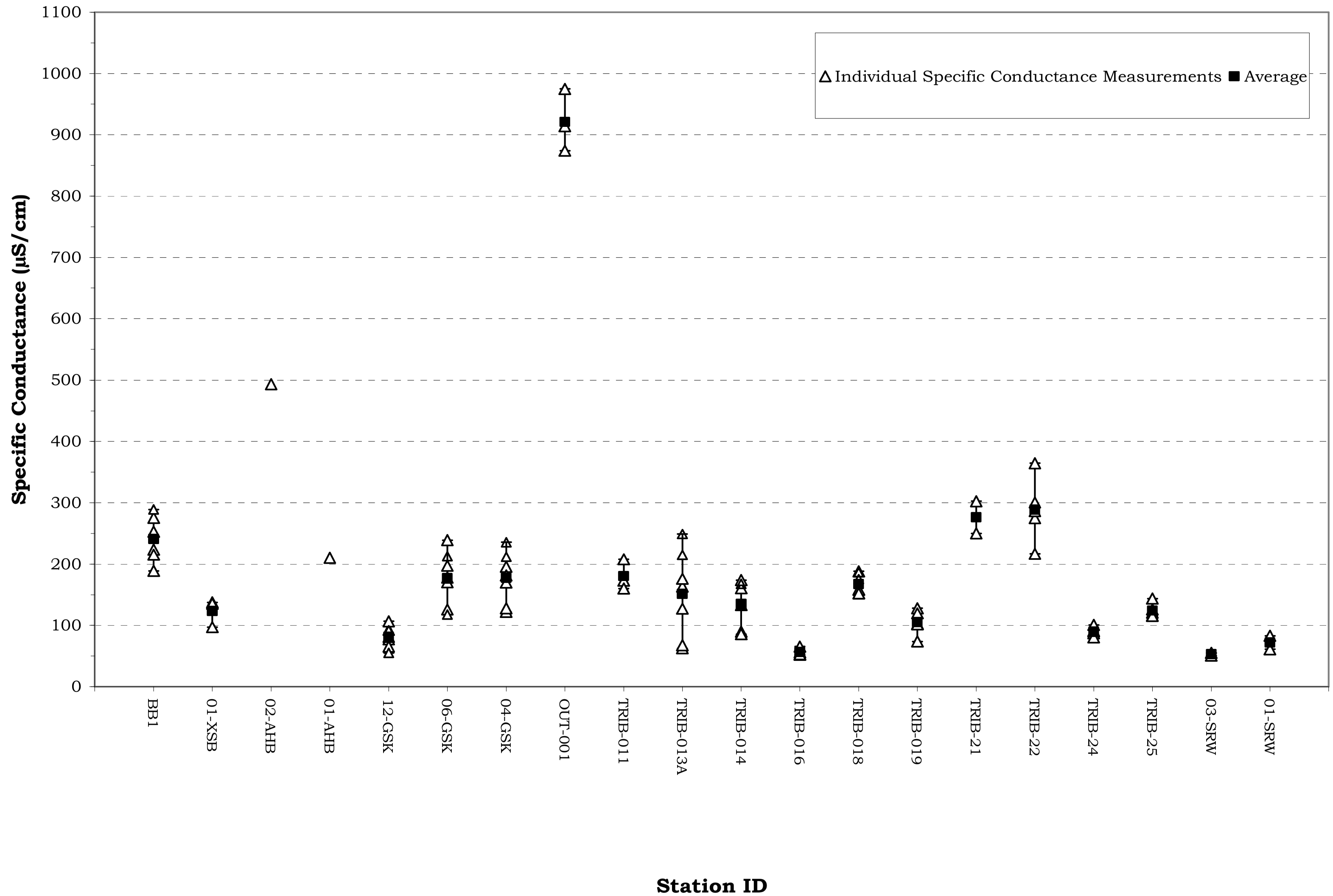
- Consider incorporating the use of in-situ dataloggers to automatically determine specific conductance levels during rain events, snowmelt, and baseline dry weather conditions. The use of these instruments is dependent upon availability, and requires coordination with NHDES.

Table 7. Specific Conductance Data Summary - Lake Winnipesaukee Tributaries, 2009

Station ID	Samples Collected	Data Range (uS/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
BB1	6	189 - 289	0	6
01-XSB	3	97 - 138	0	3
02-AHB	1	493	0	1
01-AHB	1	210	0	1
12-GSK	1	55 - 107	0	1
06-GSK	7	118 - 239	0	7
04-GSK	7	122 - 236	0	7
OUT-001	7	874 - 975	0[A]	7
TRIB-011	3	160 - 208	0	3
TRIB-013A	7	63 - 249	0	7
TRIB-014	7	86 - 174	0	7
TRIB-016	4	52 - 66	0	4
TRIB-018	7	152 - 188	0	7
TRIB-019	5	74 - 128	0	5
TRIB-21	2	250 - 302	0	2
TRIB-22	5	217 - 365	0	5
TRIB-24	5	81 - 101	0	5
TRIB-25	5	115 - 144	0	5
03-SRW	2	51 - 55	0	2
01-SRW	2	61 - 83	0	2
Total	**87**	_____	**0**	**87**

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

Figure 4. Specific Conductance Statistics for the Lake Winnipesaukee Tributaries June 22 - September 8, 2009, NHDES VRAP



4.5 Water Temperature

Between one and seven measurements were taken in the field for water temperature at 20 stations in the Lake Winnipesaukee watershed (Table 8). Of the 87 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.

Figure 5 shows the results of instantaneous water temperature measurements. The average water temperature varied from 14.6 °C. to 22.5 °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.

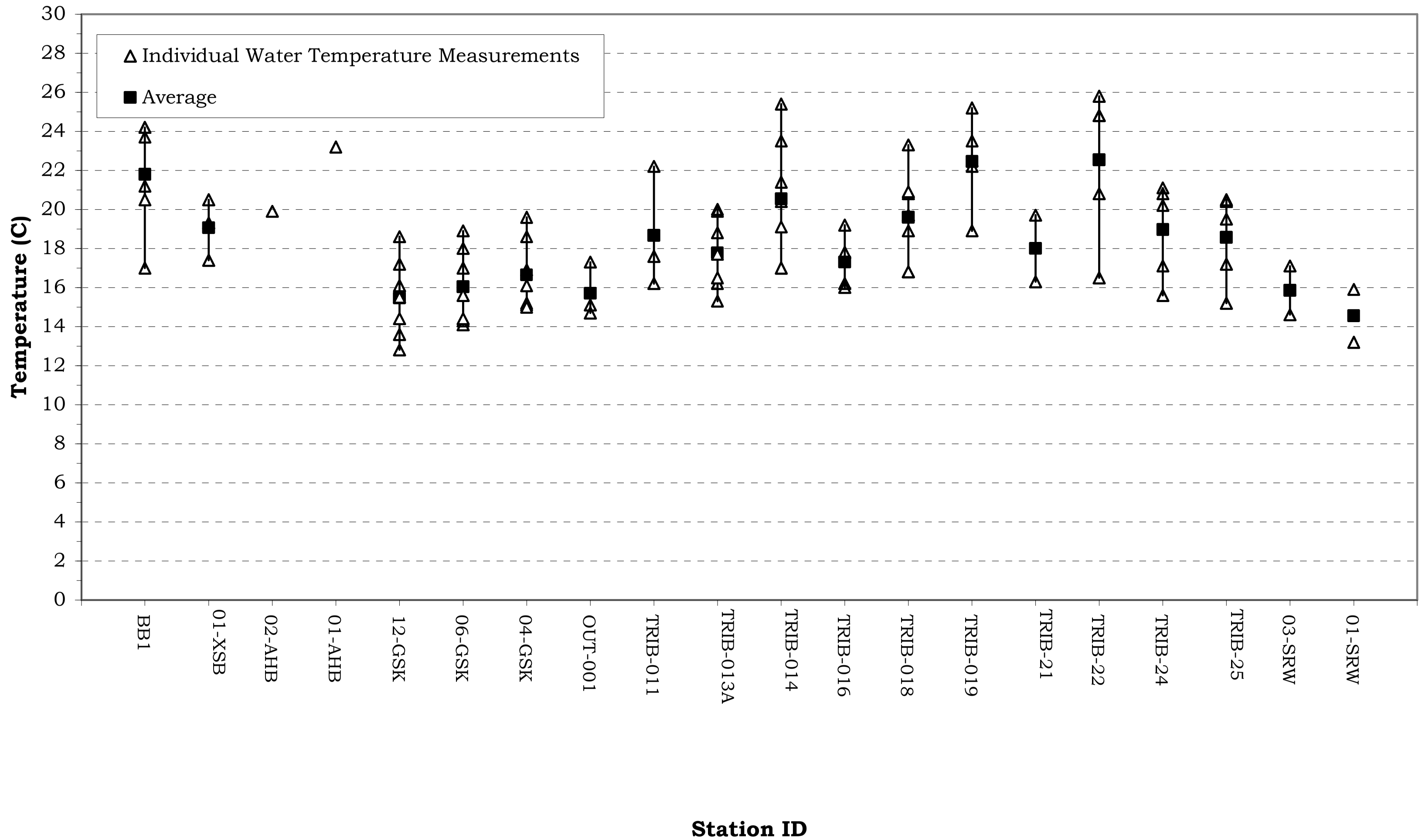
Recommendations

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

Table 8. Water Temperature Data Summary – Lake Winnipesaukee Tributaries, 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
BB1	6	17.0 - 24.2	Not Applicable	6
01-XSB	3	17.4 - 20.5	N/A	3
02-AHB	1	19.9	N/A	1
01-AHB	1	23.2	N/A	1
12-GSK	1	12.8 - 18.6	N/A	1
06-GSK	7	14.1 - 18.9	N/A	7
04-GSK	7	15.0 - 19.6	N/A	7
OUT-001	7	14.7 - 17.3	N/A	7
TRIB-011	3	16.2 - 22.2	N/A	3
TRIB-013A	7	15.3 - 20.0	N/A	7
TRIB-014	7	17.0 - 25.4	N/A	7
TRIB-016	4	16.0 - 19.2	N/A	4
TRIB-018	7	16.8 - 23.3	N/A	7
TRIB-019	5	18.9 - 25.2	N/A	5
TRIB-21	2	16.3 - 19.7	N/A	2
TRIB-22	5	16.5 - 25.8	N/A	5
TRIB-24	5	15.6 - 21.1	N/A	5
TRIB-25	5	15.2 - 20.5	N/A	5
03-SRW	2	14.6 - 17.1	N/A	2
01-SRW	2	13.2 - 15.9	N/A	2
Total	**87**	_____	**N/A**	**87**

Figure 5. Water Temperature Statistics for the Lake Winnipesaukee Tributaries
June 22 - September 8, 2009, NHDES VRAP



4.6 Total Phosphorus

Between one and seven samples were taken for total phosphorus at 18 stations in the Lake Winnipesaukee watershed (Table 9). Of the 69 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.

All but two measurements were below the NHDES "level of concern" (Figure 6). Stations TRIB-24 and TRIB-25 each had one measurement above the level of concern. Under undisturbed natural conditions phosphorus is at very low levels in aquatic ecosystems. Of the three nutrients critical for aquatic plant growth; potassium, nitrogen, and phosphorus, it is usually phosphorous that is the limiting factor to plant growth. When the supply of phosphorus is increased due to human activity, algae respond with significant growth.

Recommendations

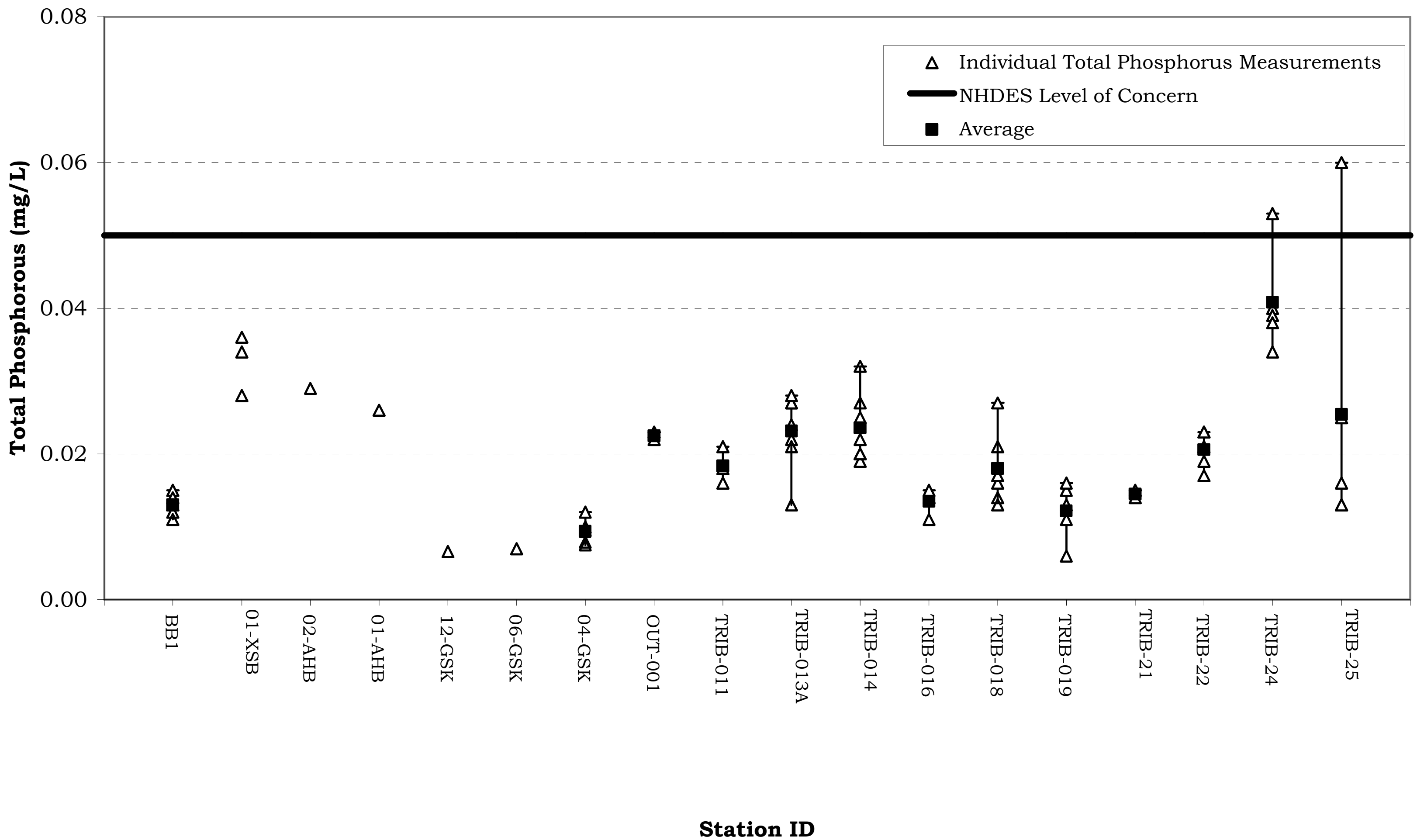
- Continue sampling at all stations in order to develop a long-term data set to better understand trends as time goes on.

Table 9. Total Phosphorus Data Summary – Lake Winnipesaukee Tributaries, 2009

Station ID	Samples Collected	Data Range (mg/l)	Acceptable Samples Not Meeting NHDES "Level of Concern"	Number of Usable Samples for 2010 NH Surface Water Quality Assessment
BB1	6	0.011 - 0.015	0	6
01-XSB	3	0.028 - 0.036	0	3
02-AHB	1	0.029	0	1
01-AHB	1	0.026	0	1
12-GSK	1	0.0066	0	1
06-GSK	1	0.007	0	1
04-GSK	5	0.0075 - 0.012	0	5
OUT-001	2	0.022 - 0.023	0[A]	2
TRIB-011	3	0.016 - 0.021	0	3
TRIB-013A	7	0.013 - 0.028	0	7
TRIB-014	7	0.019 - 0.032	0	7
TRIB-016	4	0.011 - 0.015	0	4
TRIB-018	6	0.013 - 0.027	0	6
TRIB-019	5	0.006	0	5
TRIB-21	2	0.014 - 0.015	0	2
TRIB-22	5	0.017 - 0.023	0	5
TRIB-24	5	0.034 - 0.053	1	5
TRIB-25	5	0.013 - 0.060	1	5
Total	**69**	_____	**2**	**69**

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

Figure 6. Total Phosphorus Statistics for the Lake Winnipesaukee Tributaries
June 22 - September 8, 2009, NHDES VRAP



4.7 Nitrogen – Nitrate (NO_3) + Nitrite (NO_2)

Between one and five samples were taken for nitrate (NO_3) + nitrite (NO_2) at 17 stations in Lake Winnipesaukee watershed (Table 10). Of the 45 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 nitrate/nitrite for Class A or 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. Nitrate/Nitrite Data Summary – Lake Winnipesaukee Tributaries, 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
BB1	2	ND - 0.084	Not Applicable	2
01-XSB	3	ND[B]	N/A	3
01-AHB	1	ND[B]	N/A	1
12-GSK	1	0.088	N/A	1
06-GSK	1	0.016	N/A	1
04-GSK	2	0.160 - 0.500	N/A	2
OUT-001	1	2	0[A]	1
TRIB-011	1	0.090	N/A	1
TRIB-013A	5	0.068 - 0.640	N/A	5
TRIB-014	5	0.068 - 0.420	N/A	5
TRIB-016	2	ND[B]	N/A	2
TRIB-018	5	ND[B] - 0.052	N/A	5
TRIB-019	4	ND[B] - 0.056	N/A	4
TRIB-21	1	0.095	N/A	1
TRIB-22	4	0.053 - 0.120	N/A	4
TRIB-24	4	0.059 - 0.160	N/A	4
TRIB-25	3	ND[B] - 0.099	N/A	3
Total	**45**	_____	**0**	**45**

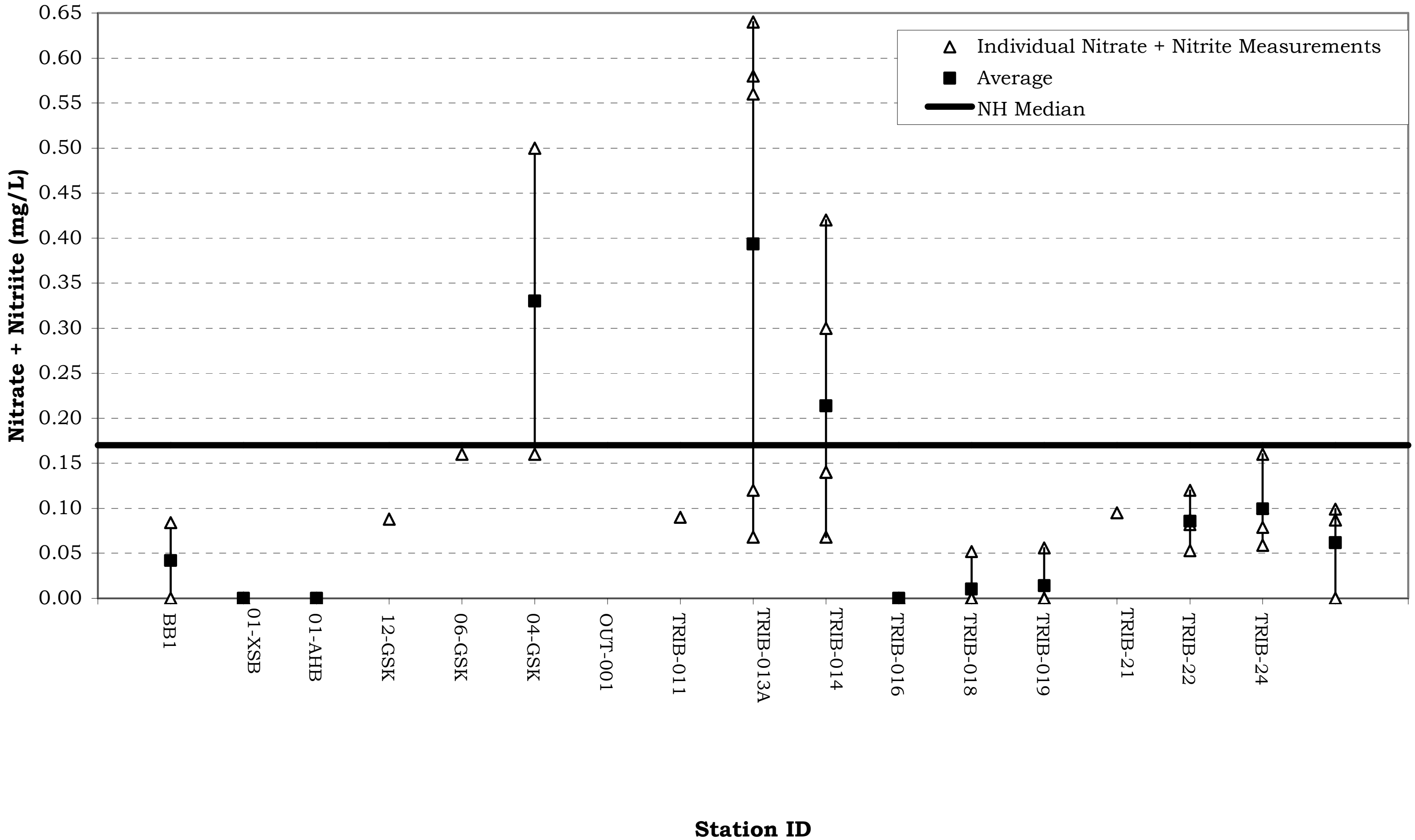
[A] Stormwater pipes are not considered surface waters and thus water quality standards do not generally apply.
[B] NHDES Laboratory detection limit for nitrate + nitrite is 0.05 mg/L

Although there is no numeric standard for nitrate/nitrite, 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 (04-GSK, TRIB-013A, and TRIB-014) had one or more measurement that exceeded the NO_3+NO_2 state median. (Figure 7).

Recommendations

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

Figure 7. Nitrate (NO_3)/Nitrite (NO_2) Statistics for the Lake Winnipesaukee Tributaries June 22 - September 8, 2009, NHDES VRAP



4.8 Chloride

Between one and five samples were taken for chloride at 17 stations in the Lake Winnipesaukee watershed [Table 11]. Of the 48 measurements taken, all met quality assurance/quality control requirements and are usable for New Hampshire's 2010 surface water quality report to the US Environmental Protection Agency.

The Class B New Hampshire surface water quality standard for chloride is as follows:

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

Table 11. Chloride Data Summary – Lake Winnipesaukee Tributaries, 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
BB1	3	47 - 56	0	3
01-XSB	3	5 - 8	0	3
02-AHB	1	130	0	1
12-GSK	1	8.7	0	1
06-GSK	1	20	0	1
04-GSK	2	23 - 40	0	2
OUT-001	1	260	0[A]	1
TRIB-011	1	27	0	1
TRIB-013A	5	11 - 40	0	5
TRIB-014	5	13 - 25	0	5
TRIB-016	3	7 - 9	0	3
TRIB-018	5	25 - 50	0	5
TRIB-019	4	18 - 25	0	4
TRIB-21	1	66	0	1
TRIB-22	4	54 - 78	0	4
TRIB-24	4	10 - 14	0	4
TRIB-25	4	21 - 26	0	4
Total	**48**	_____	**0**	**48**

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

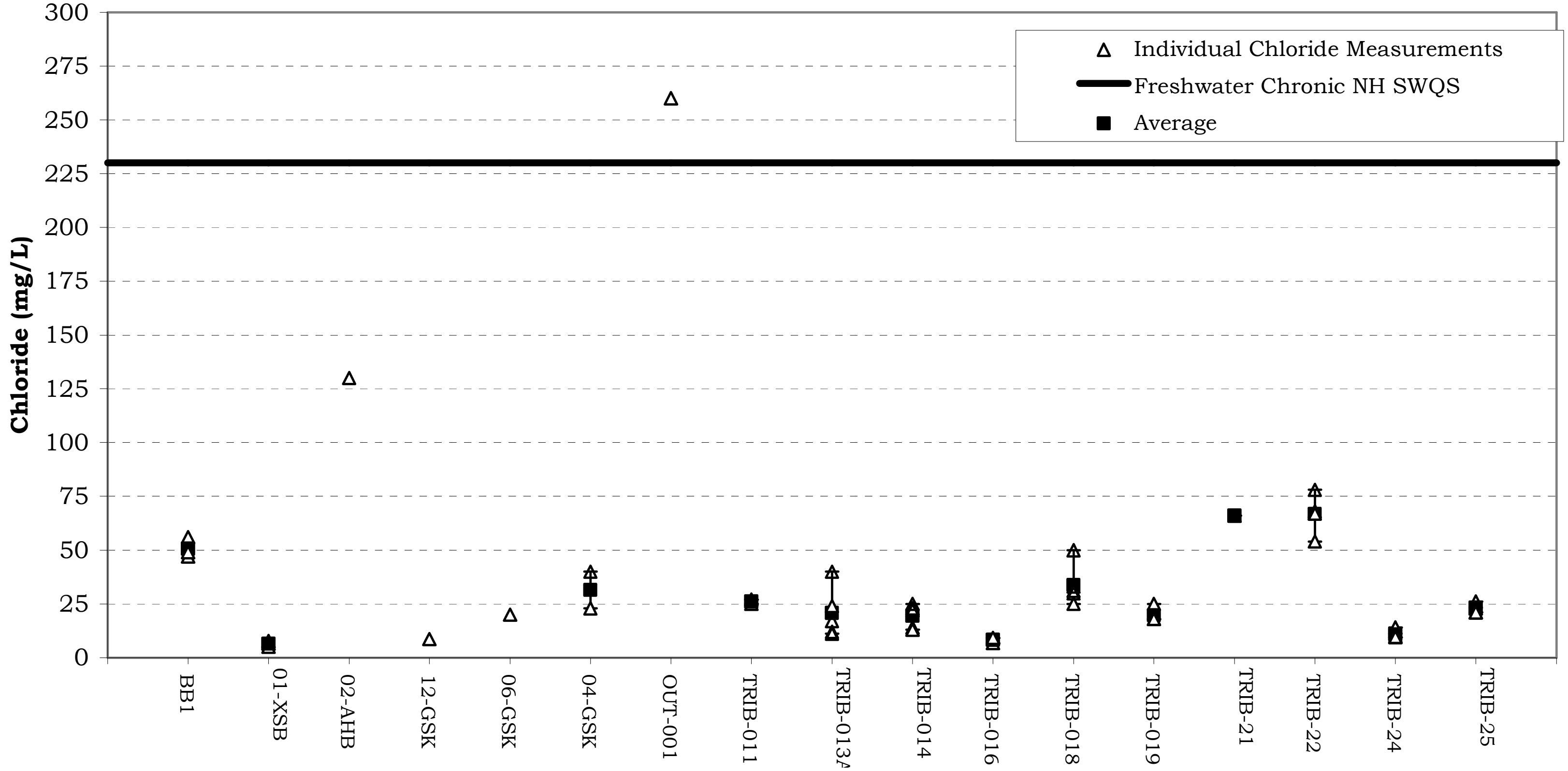
All surface water samples for chloride were below the state of New Hampshire Class B chronic surface water quality standard of 230 mg/L (Figure 8).

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.

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.

Figure 8. Chloride Statistics for the Lake Winnipesaukee Tributaries
June 22, 2009 - September 8, 2009, NHDES VRAP



APPENDIX A: LAKE WINNIPESAUKEE TRIBUTARIES WATER QUALITY DATA

Measurements not meeting New Hampshire surface water quality standards
Measurements not meeting NHDES quality assurance/quality control standards
Total Phosphorous measurements exceeding NHDES level of concern

[A] Chronic water quality standard

BB1, Black Brook, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	Nitrite (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative	Narrative
06/22/2009	14:10	8.34	86.6	6.62	0.61	275.5	17.0	56	0.012		0.084
07/13/2009	13:36	8.34	93.4	6.70	0.68	223.5	21.2		0.015		
07/28/2009	13:20	7.92	94.4	6.76	0.53	188.8	24.2	47	0.014		ND
08/10/2009	14:55	8.62	102.9	6.79	0.48	215.2	24.2	49	0.013	ND	
08/25/2009	14:05	7.84	92.5	6.79	1.02	252.7	23.7		0.013		
09/08/2009	15:50	8.75	97.1	6.87	0.66	289.2	20.5		0.011		

01-XSB, Unknown Tributary to Sander's Bay, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
07/28/2009	11:00	3.47	38.4	6.14	9.73	97.0	20.5	6.5	0.028	ND
08/10/2009	12:20	2.58	28.2	6.35	15.20	137.6	19.3	5.1	0.034	ND
09/08/2009	12:45	4.12	42.9	6.14	13.60	135.6	17.4	7.7	0.036	ND

02-AHB, Adder Hole Brook, Upstream, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
08/10/2009	12:45	6.81	74.7	6.15	1.05	493.4	19.9	130	0.029	ND

01-AHB, Adder Hole Brook, Downstream, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Total Phosphorus (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	Narrative
07/28/2009	10:27	6.94	81.3	6.05	0.24	210.2	23.2	0.026

12-GSK, Gunstock River, Hoyt Road, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
07/14/2009	09:15	10.30	97.3	6.27	0.05	77.3	12.8			
07/28/2009	09:00	9.24	94.0	6.24	0.57	65.6	16.1			
08/10/2009	14:25	10.03	104.1	6.25	0.34	81.1	17.2			
08/25/2009	13:40	9.87	105.4	6.37	0.21	93.0	18.6			
09/22/2009	15:30	10.52	101.0	6.26	0.19	106.5	13.6			
06/23/2009	09:20	9.57	93.8	6.35	0.29	55.3	14.4	8.7		0.088
09/08/2009	14:35	11.57	115.2	6.35	0.12	91.8	15.5		0.007	

06-GSK, Gunstock River, Intervale Road, Alton

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
07/14/2009	10:11	10.75	104.7	6.84	0.36	170.5	14.3			
07/28/2009	09:43	9.49	98.3	6.85	0.67	126.0	17.0			
08/10/2009	13:45	9.78	102.9	6.99	0.60	178.0	18.0			
08/25/2009	12:40	9.30	99.7	7.15	0.51	197.1	18.9			
09/22/2009	15:00	10.51	102.2	7.08	0.24	239.0	14.1			
06/23/2009	10:00	9.82	96.0	6.63	0.46	117.5	14.4	20		0.160
09/08/2009	13:40	10.69	107.2	7.03	0.32	212.5	15.6		0.007	

04-GSK, Gunstock River, Old Lake Shore Road, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	Nitrite (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative	Narrative
08/25/2009	12:25	9.59	104.5	6.65	0.44	195.7	19.6				
06/23/2009	10:20	9.46	94.7	6.49	0.28	122.0	15.2	23			0.500
07/14/2009	10:28	9.96	98.8	6.45	0.62	169.9	15.1		0.010		
07/28/2009	10:00	9.32	96.5	6.52	0.75	127.8	16.9		0.012		0.160
08/10/2009	13:25	9.95	106.3	6.51	0.69	181.3	18.6	40	0.010	0.270	
09/08/2009	13:20	11.26	114.2	6.44	0.34	211.9	16.1		0.008		
09/22/2009	14:30	11.17	110.8	6.45	0.44	235.6	15.0		0.008		

OUT-001, Outfall Pipe at End of Mass Ave, Laconia

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

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	10:24	9.07	89.7	6.42	0.95	914.0	14.7			
07/13/2009	14:26	8.85	88.6	6.23	0.18	975.0	15.1		0.022	
09/08/2009	09:30	7.88	81.9	6.32	0.51	874.0	17.3	260	0.023	2.000

TRIB-011, Golf Course Tributary at Paugus Road & North Street Intersection, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	11:05	7.73	78.6	6.50	1.51	173.3	16.2	25	0.018	
07/13/2009	14:42	8.25	86.6	6.46	0.58	207.7	17.6		0.016	
07/28/2009	14:35	7.72	81.3	6.56	1.42	160.1	22.2	27	0.021	0.090

TRIB-013A, Tributary to Paugus Bay, Upstream of Outerbridge Drive, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	11:54	8.52	84.8	6.21	2.31	127.2	15.3	17	0.027	
07/13/2009	09:40	8.16	84.6	6.48	1.05	163.3	16.2		0.022	
07/28/2009	15:10	8.33	91.6	5.90	0.29	62.7	20.0	11	0.027	0.120
08/10/2009	10:15	8.90	95.2	6.57	0.82	175.9	18.8	24	0.024	0.560
08/25/2009	10:25	7.08	77.8	5.78	0.27	67.5	19.9	12	0.028	0.068
09/08/2009	11:05	7.88	82.7	6.50	0.14	215.0	17.7	40	0.013	0.640
09/22/2009	10:55	8.36	85.4	6.77	0.46	248.8	16.5		0.021	0.580

TRIB-014, Tributary Outlet to Paugus Bay Through South Down, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	12:16	8.72	90.2	6.44	2.55	89.9	17.0	14	0.019	
07/13/2009	10:15	7.89	87.9	6.75	2.51	132.9	20.4		0.020	
07/28/2009	15:30	8.17	99.5	6.41	1.58	85.6	25.4	13	0.025	0.140
08/10/2009	09:55	8.54	96.5	6.88	2.62	160.5	21.4	23	0.022	0.300
08/25/2009	10:05	7.83	91.9	6.97	2.08	174.0	23.5	22	0.020	0.140
09/08/2009	10:40	9.21	99.4	6.92	3.41	134.3	19.1	25	0.032	0.420
09/22/2009	11:20	11.15	115.3	7.45	3.01	167.7	17.0		0.027	0.068

TRIB-016, Tributary to Paugus Bay, State Forest, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	12:50	9.57	96.6	6.44	0.16	55.8	16.0	8.9	0.011	
07/13/2009	10:45	9.09	92.3	6.54	0.13	52.1	16.2		0.014	
08/10/2009	09:22	8.93	94.0	6.33	0.07	53.1	17.8	6.7	0.014	ND
08/25/2009	09:30	8.25	89.6	6.47	0.09	65.5	19.2	9.2	0.015	ND

TRIB-018, Tributary to Paugus Bay, Pickerel Cove, Upstream, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
07/08/2009	10:28	4.51	52.7	6.21	1.71	188.4	23.3			
06/22/2009	14:25	7.38	75.7	6.37	1.80	152.2	16.8	25	0.013	ND
07/13/2009	11:55	7.33	80.1	6.51	1.56	157.6	19.7		0.027	
07/28/2009	11:43	7.48	83.4	6.41	0.78	158.5	20.8	31	0.016	ND
08/10/2009	10:55	7.65	82.0	6.36	1.65	152.4	18.9	30	0.017	ND
08/25/2009	10:55	6.51	73.1	6.37	1.55	175.7	20.9	33	0.021	ND
09/08/2009	11:45	8.71	89.7	6.41	1.98	186.7	16.8	50	0.014	0.052

TRIB-019, Tributary to Paugus Bay, Pickerel Cove, Downstream, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	14:45	7.99	86.8	6.52	1.39	128.0	18.9	25	0.015	ND
07/13/2009	12:15	8.74	100.6	6.76	0.85	119.8	22.5		0.016	
08/10/2009	11:15	8.42	98.6	6.73	0.51	102.6	23.5	18	0.013	ND
08/25/2009	11:25	7.68	93.2	6.65	0.60	102.0	25.2	18	0.011	ND
09/08/2009	12:10	8.70	99.8	6.66	0.19	73.7	22.2	18	0.006	0.056

TRIB-21, Black Brook, Gilford Plaza, Gilford

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	14:28	8.70	88.6	6.62	0.85	302.4	16.3	66	0.015	0.095
07/13/2009	13:52	7.87	86.7	6.64	0.89	250.1	19.7		0.014	

TRIB-022, Black Brook, Union Ave, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	17:15	6.87	70.8	6.28	2.47	300.3	16.5	68	0.023	0.087
07/13/2009	14:06	7.69	85.3	6.38	2.36	274.9	20.8		0.023	
07/28/2009	13:50	8.05	96.9	6.54	1.26	216.7	24.8	54	0.021	0.053
08/10/2009	16:15	9.32	112.0	6.34	2.36	286.4	24.8	67	0.017	0.082
08/25/2009	14:55	9.30	114.2	6.47	3.09	364.5	25.8	78	0.019	0.120

TRIB-24, Langley Brook, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	15:45	9.21	92.5	6.64	1.77	90.3	15.6	14	0.034	0.079
07/13/2009	13:00	9.27	95.1	6.63	0.45	87.0	17.1		0.040	
07/28/2009	12:35	8.91	98.1	6.59	0.48	80.5	20.2	10	0.039	0.059
08/10/2009	15:30	8.62	96.3	6.56	0.88	91.1	20.8	9.7	0.038	0.100
08/25/2009	14:30	8.71	97.5	6.67	1.03	100.7	21.1	9.5	0.053	0.160

TRIB-25, Unnamed Tributary to Moulton's Cove, Laconia

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)	Chloride (mg/L)	Total Phosphorus (mg/L)	N02+N03 (mg/L)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA	230[A]	Narrative	Narrative
06/22/2009	15:12	9.19	91.5	6.65	0.55	116.0	15.2	21	0.013	
07/13/2009	11:33	9.11	94.7	6.71	0.40	120.7	17.2		0.013	
07/28/2009	12:12	8.46	93.6	6.76	0.78	125.9	20.4	23	0.016	ND
08/10/2009	11:40	8.99	98.0	6.73	1.06	115.2	19.5	21	0.060	0.099
08/25/2009	11:45	8.26	91.7	6.62	1.04	143.6	20.5	26	0.025	0.087

03-SRW, Smith River, Crescent Lake Outlet, Wolfeboro

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA
09/30/2009	11:33	9.16	92.1	6.28	0.00	55.3	17.1
10/09/2009	14:09	9.66	95.6	6.75	0.65	50.9	14.6

01-SRW, Smith River, Back Bay Outlet, Wolfeboro

Date	Time of Sample	DO (mg/L)	DO (% sat.)	pH	Turbidity (NTUs)	Specific Conductance (uS/cm)	Water Temp. (°C)
Standard	NA	>5.0	>75% Daily Average	6.5-8.0	<10 NTU above backgrd	(µS/cm as chloride surrogate)	NA
09/30/2009	10:34	8.57	86.8	6.15	0.12	83.1	15.9
10/09/2009	13:10	9.66	93.6	6.22	0.16	61.2	13.2

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 bv more than 10 NTU.

Physical Parameters

Temperature

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

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

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

Class B NH Surface Water Quality Standard: No numeric standard

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

Chlorophyll-a (Chlor a)

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

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

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

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

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

Total Phosphorus (TP)

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

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

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

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

Total Kjeldahl Nitrogen (TKN)

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

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

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

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

Other Parameters

Chloride

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

Acute Standard: 860 mg/L.

Chronic Standard: 230 mg/L.

Escherichia Coliform Bacteria *(E. coli)*

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

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

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

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

Metals

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

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

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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.