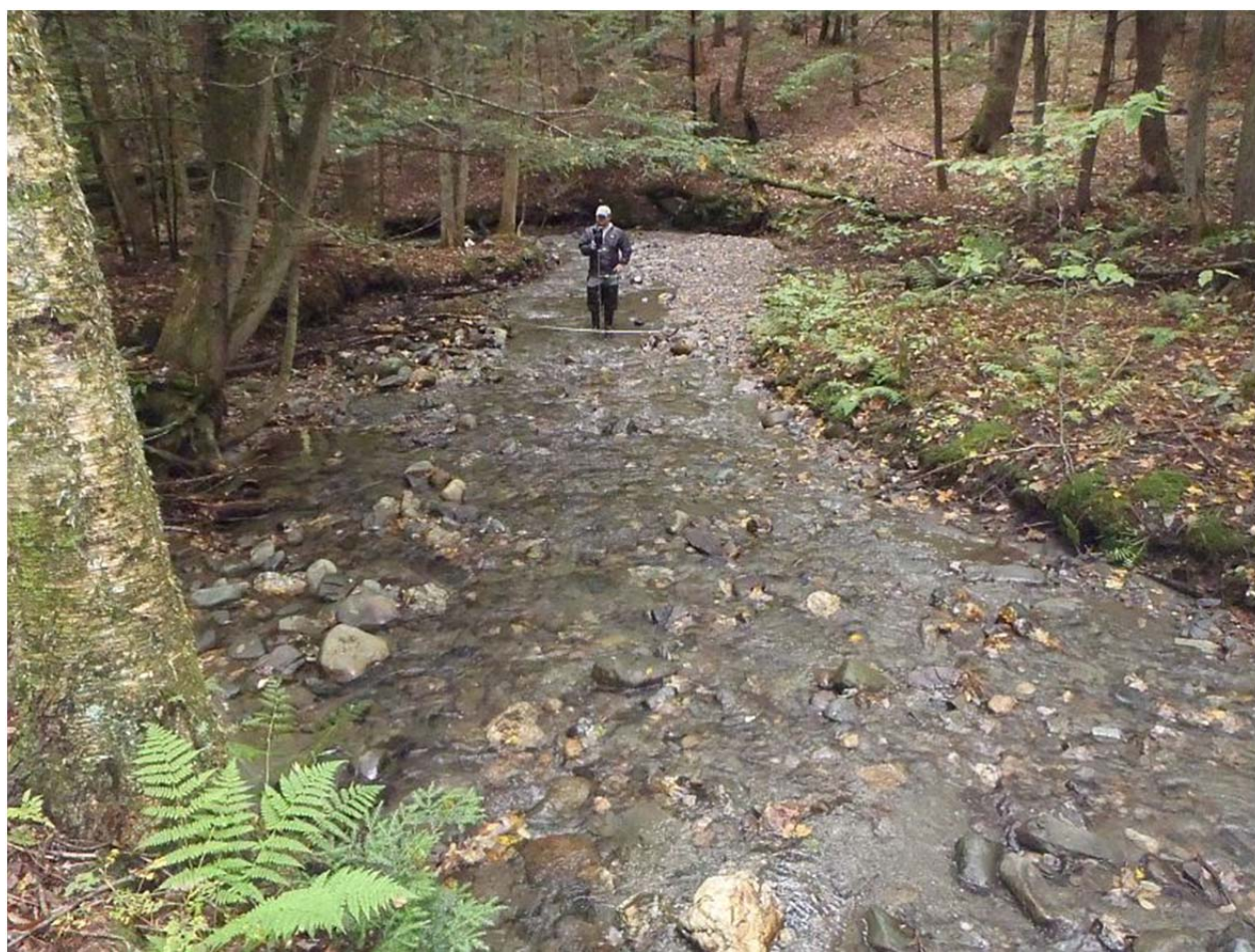




Water Quality Monitoring at Saint-Gaudens National Historic Site

Northeast Temperate Network 2011 Summary Report

Natural Resource Data Series NPS/NETN/NRDS—2012/336



ON THE COVER

Measuring stream flow (discharge) at Blow-Me-Down Brook, September 2011

Photograph by: Brian Schuetz

Water Quality Monitoring at Saint-Gaudens National Historic Site

Northeast Temperate Network 2011 Summary Report

Natural Resource Data Series NPS/NETN/NRDS—2012/336

William G. Gawley
National Park Service
Acadia National Park
PO Box 177
Bar Harbor, Maine 04609

June 2012

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available from the Northeast Temperate Network website (<http://science.nature.nps.gov/im/units/netn/reports/reports.cfm>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>).

Please cite this publication as:

Gawley, W. G. 2012. Water quality monitoring at Saint-Gaudens National Historic Site: Northeast Temperate Network 2011 summary report. Natural Resource Data Series NPS/NETN/NRDS—2012/336. National Park Service, Fort Collins, Colorado.

Contents

	Page
Figures.....	v
Tables	vii
Introduction.....	1
Sampling Sites	1
Methods.....	2
Water Quality Standards	3
Results.....	4
Water Quality.....	5
Specific Conductance.....	5
pH Level.....	6
Temperature	7
Dissolved Oxygen.....	8
Acid Neutralizing Capacity.....	9
Apparent Color.....	10
Nutrient Enrichment	11
Transparency	11
Phosphorus.....	12
Nitrogen	13
Water Quantity.....	14
Invasive Aquatic Plants	15
Summary	16
Literature Cited	19
Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011.	21

Figures

	Page
Figure 1. NETN water monitoring sites at Saint-Gaudens NHS.	2
Figure 2. Explanation of box plot graph	4
Figure 3. Specific conductance from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.....	5
Figure 4. pH from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.....	6
Figure 5. Water temperature (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.	7
Figure 6. Dissolved oxygen (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.	8
Figure 7. Acid neutralizing capacity from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.	9
Figure 8. Apparent color from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.	10
Figure 9. Secchi disk, measuring tape, and viewing scope (left) and view of submerged Secchi disk through viewing scope (right).	11
Figure 10. Total phosphorus (TP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP) from spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011. There is no numeric New Hampshire state water quality TP standard.....	12
Figure 11. Total nitrogen (TN), total dissolved nitrogen (TDN), nitrite + nitrate ($\text{NO}_2 + \text{NO}_3$), and nitrite (NO_2) from 2011 spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011.....	13
Figure 12. Pond and stream stage obtained in 2011 by measuring from a permanent datum point down to the water surface. <i>Note: Larger tapedown distances indicate LOWER water levels.</i>	14

Tables

	Page
Table 1. Water quality monitoring sites at Saint-Gaudens NHS.....	1
Table 2. New Hampshire stream water quality standards.....	3
Table 3. EPA Ecoregion 8 nutrient criteria	4
Table 4. Maine Center for Invasive Aquatic Plants species of concern.....	15
Table 5. U.S. Geological Survey Nonindigenous Aquatic Species of concern.	16

Introduction

This report on the water quality of Saint-Gaudens National Historic Site (SAGA) generated by the Northeast Temperate Network (NETN) Water Quality Monitoring Program includes data gathered in the 2011 monitoring season and displays these results in graphic form, accompanied by a brief interpretation. Appendix A contains data collected from 2006 through 2011.

The vital signs for freshwater bodies included in the NETN Freshwater Monitoring Protocol (Lombard et al 2006) are water chemistry, nutrient enrichment, water quantity, and the detection of invasive plant species. These metrics were chosen to address the NPS Inventory and Monitoring Program objective to detect change in the status of physical, chemical, or biological attributes of the ecosystem.

The NETN Freshwater Monitoring Protocol calls for a total of one park pond and two park streams to be sampled monthly from May through October. A cooperator from the University of Vermont or a NETN hydrologic technician measured physical and in-situ water chemistry parameters each month and periodically collected water samples for analysis at the University of Maine's Sawyer Environmental Chemistry Research Laboratory. All monitoring data are incorporated into a series of comprehensive databases that ultimately feed the U.S. Environmental Protection Agency's "STORET" data system, the repository for all NPS water quality and quantity data.

Sampling Sites

Three water quality monitoring sites have been selected at SAGA for the long-term monitoring program (Table 1). The three sites selected to represent the two streams and the major impoundment in the park are all water quality sites that have been measured by the park since 1997 (Walasewicz 2003). The site behind the impoundment on Blow-Me-Down Pond (SAGAPA) was the park's historic Site 5. The stream site on Blow-Me-Up Brook (SAGASA) was historic Site 1, and the site on Blow-Me-Down Brook (SAGASB), located below the confluence with Blow-Me-Up Brook, was historic Site 3 (Figure 1).

Blow-Me-Up Brook is classified as a cold water fishery, loosely defined as water that can support, on a year-round basis, wild and stocked brook trout (*Salvelinus fontinalis*) or other species requiring similar conditions. Blow-Me-Down Brook is considered a warm water fishery, capable of supporting bass, pickerel, sunfish, and similar species.

Table 1. Water quality monitoring sites at Saint-Gaudens NHS

Waterbody	NETN Site Code	Latitude	Longitude	Site Remarks
Blow-Me-Down Pond (Pond A)	SAGAPA	43.49725	-72.3754	
Blow-Me-Up Brook (Stream A)	SAGASA	43.5018833	-72.3708333	Cold water fisheries - includes trout
Blow-Me-Down Brook (Stream B)	SAGASB	43.5033333	-72.3790833	Warm water fisheries- includes sunfish

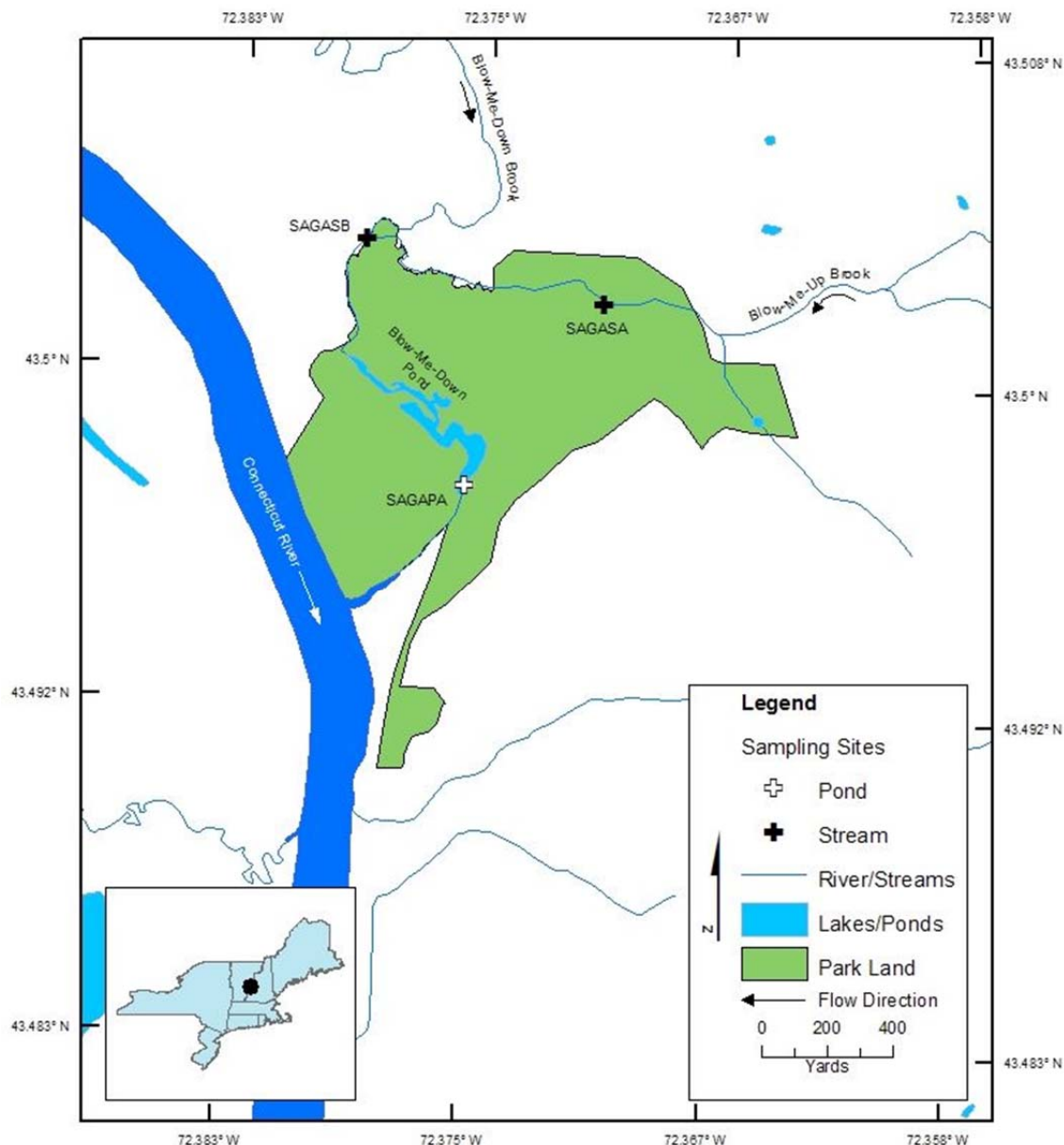


Figure 1. NETN water monitoring sites at Saint-Gaudens NHS.

Methods

Detailed descriptions of all monitoring methods are found in the protocol (Lombard et al. 2006). Monthly sampling parameters included in-situ water quality measures (pH, specific conductance, temperature, and dissolved oxygen) determined with a YSI 600XL sonde, transparency (pond site only), weather, stream flow (discharge), and stream and pond stage. In May (streams only), June (pond only) and August (both streams and pond), water samples were obtained and analyzed for acid neutralizing capacity (ANC), color, and nutrients. The pond sampling procedure entailed collecting all in-situ measurements and water samples from the location of the deepest point of

the pond (approximately 1.5 meters). Nutrient chemistry parameters were analyzed from a half-meter grab sample.

Stream discharge was measured using U.S. Geological Survey protocols (Rantz et al. 1982), employing a measuring tape, wading rod, and SonTek FlowTracker or a Price Pygmy current meter to measure a particular cross-sectional area of the stream and the velocity of the water at that cross section.

In-situ stream water chemical and physical measurements and water samples were collected within 5 meters of the location of the discharge measurement. Sonde measurements were taken in the main stream flow with care taken that the sonde was not resting directly on the stream bottom. Grab samples were obtained by submerging the sample bottle directly in the stream with a gloved hand. A peristaltic pump and Tygon tubing were used to collect samples if water levels were too low to completely submerge a bottle.

Water Quality Standards

Surface waters of National Forests and surface waters designated as natural are considered outstanding resource waters (ORW) in New Hampshire. “Water quality shall be maintained and protected in surface waters that constitute ORW” (New Hampshire Department of Environmental Services 1999). Class A is the most protective surface-water classification in New Hampshire’s Surface-Water Quality Regulations (New Hampshire Department of Environmental Services 1999). “Standards for temperature, pH, Color, nitrogen, and phosphorus are as naturally occurring in Class A waters. The pH of class B, the next most restrictive class, ranges from 6.5 to 8.0. Class A waters have a DO content standard of at least 75 percent saturation on the basis of a daily average, and an instantaneous minimum of at least 6 mg/L at any place or time except when concentrations of DO are less than 6 mg/L from natural causes. In cold water fish spawning areas from October 1 through May 14, the instantaneous minimum DO concentration shall be at least 8 mg/L” (New Hampshire Department of Environmental Services 1999).

“Surface waters within the top 25 percent of depth of thermally unstratified lakes, ponds, impoundments, and reservoirs or within the epilimnion shall contain a DO concentration of at least 75 percent saturation and instantaneous minimum DO concentration of at least 5 mg/L” (New Hampshire Department of Environmental Services 1999).

Table 2. New Hampshire stream water quality standards.

Water Body	Minimum Dissolved Oxygen (mg/L)	pH range (standard units)	Maximum Total Nitrogen (µg/L)	Maximum Total Phosphorus (µg/L)
Streams	6.0	6.5-8.0	As naturally occurs	As naturally occurs
Lakes and Ponds	5.0	6.0-9.0	As naturally occurs	As naturally occurs

EPA Ecoregion 8 water quality criteria (Table 2; U.S. Environmental Protection Agency 2000a, 2000b) are also used as a benchmark in this report. EPA water quality criteria for nutrients help translate narrative criteria within State or Tribal water quality standards by establishing values for causal variables (e.g., total nitrogen and total phosphorus) and response variables (e.g., turbidity and chlorophyll *a*). Causal variables are necessary to provide sufficient protection of

designated uses before impairment occurs and to maintain downstream uses. Early response variables are necessary to provide warning signs of possible impairment and to integrate the effects of variable and potentially unmeasured nutrient loads (U.S. Environmental Protection Agency 2002).

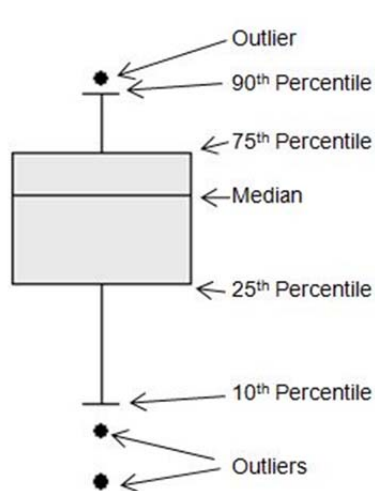
Table 3. EPA Ecoregion 8 nutrient criteria.

Nutrient Criteria	Streams	Lakes
Total Phosphorus	10 µg/L	8 µg/L
Total Nitrogen	0.38 mg/L	0.24 mg/L
Chlorophyll a	0.63 µg/L	2.43 µg/L
Secchi disk depth	N/A	4.93 m

These criteria were developed specifically for Ecoregion 8 (which includes the entire states of Maine, New Hampshire, and Vermont) and are designed to represent conditions of surface waters that are minimally impacted by human activities and thus protect against the adverse effects of nutrient over-enrichment from cultural eutrophication. The values are EPA's scientific recommendations regarding ambient concentrations of nutrients that protect aquatic resource quality. They do not have any regulatory impact or meaning.

For lakes (waterbodies greater than 10 acres and with mean water residence time of 14 or more days; U.S. Environmental Protection Agency 2000a), the criteria were established based on the lower 25th percentile of lakes that EPA found data for. This percentile of all lakes is expected to approximately correspond to the 75th percentile of reference (undisturbed) lakes. In other words, 75% of lakes in the ecoregion do not meet the criteria, nor do roughly 25% of reference lakes. For streams and rivers, a parallel approach was used to establish the nutrient criteria (U.S. Environmental Protection Agency 2000b).

Results



Monitoring results for 2011 are displayed in scatter-plot graphs showing all data for each site for a given parameter. The scatter plots of 2011 data are overlaid on box plots representing the overall range and distribution of data values collected from 2006 through 2011 for the specified parameter and site (Appendix A contains all data in tabular form). A box plot (Figure 2) is a summary plot that graphs data as a box representing statistical values. The boundary of the box closest to zero indicates the 25th percentile, a line within the box marks the median, and the boundary of the box farthest from zero indicates the 75th percentile. Whiskers (error bars) above and below the box indicate the 90th and 10th percentiles respectively. Outliers are displayed as black filled circles. If EPA or other water quality criteria exist for a particular parameter they are displayed on the graphs as specification lines.

Figure 2. Explanation of box plot graph.

Water Quality

Measures of water quality include specific conductance, pH, water temperature, dissolved oxygen (DO), acid neutralizing capacity (ANC), and apparent color. Assessment of water quality data aids in the interpretation of the biotic condition and ecological processes of surface water resources.

Specific Conductance

Specific conductance (Figure 3) is a measure of the ability of water to carry an electrical current, and is directly related to the level of dissolved ions in the water. An increase in specific conductance can be an indicator of pollutants in the water. Naturally occurring values range from less than 20 to more than 1,000 microsiemens per centimeter ($\mu\text{S}/\text{cm}$). Specific conductance values from 2011 were within the appropriate range for moderate ionic strength waters, and were generally within the range of values shown on the box plot. May specific conductance values for all sites fell in the lower range of variability.

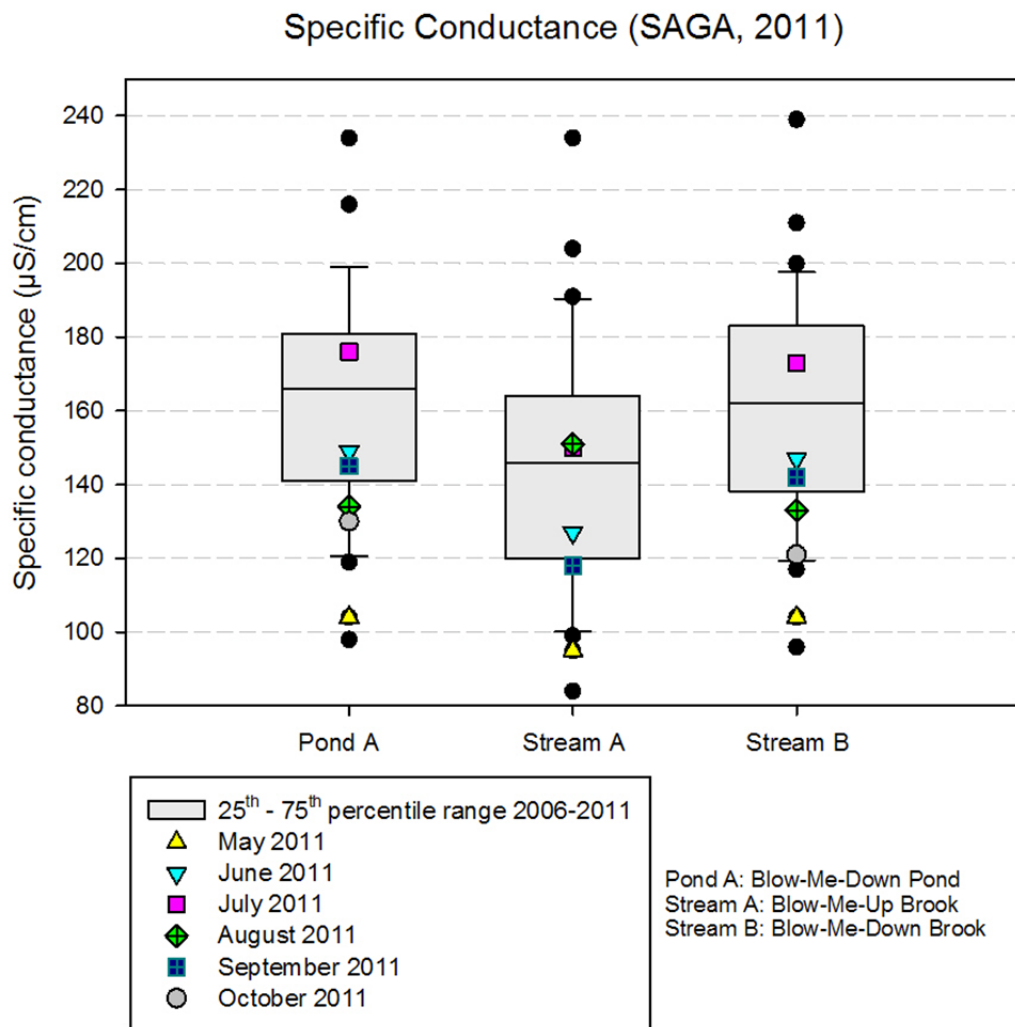


Figure 3. Specific conductance from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

pH Level

The pH of a water body reflects how acidic or basic the water is, measured on a scale of 1 to 14, with 7 being neutral. Acid waters are below 7, and alkaline waters are above 7. A one unit change in pH represents a 10-fold change in acidity or alkalinity. New Hampshire stream water quality standards, similar to those of most northeast states, indicate that a pH between 6.5 and 8.0 is within the acceptable range. The pH range for New Hampshire lake and pond water quality standards is from 6.0 to 9.0. The pH values from the 2011 monitoring season (Figure 4) were basic, and were all between the upper and lower New Hampshire water quality standards.

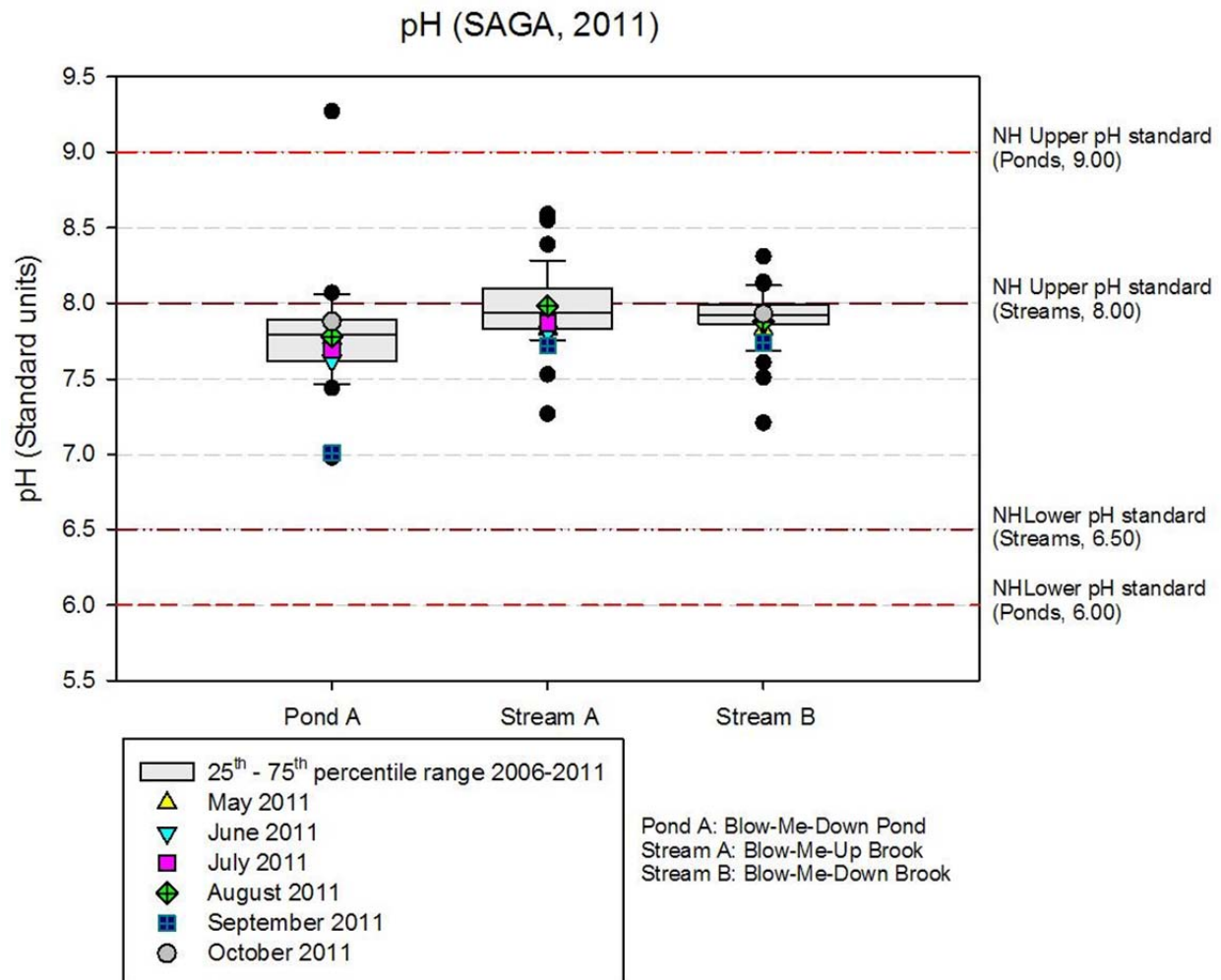


Figure 4. pH from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Temperature

Temperature can affect water chemistry and biology. For example, the amount of oxygen that water can hold is directly related to the temperature of the water. The higher the temperature, the less oxygen water can hold, which can be observed in both diel (day and night) and seasonal shifts. Oxygen will naturally decline during the summer months as water temperatures rise. Temperature can also determine the kinds of plants and animals found in the lake or pond. Certain species of fish, insects, and algae will predominate during the cooler temperatures of the spring and fall, yet be less apparent during the warmer temperatures of summer. Surface water temperatures (Figure 5) appeared to be within the normal range of variability in 2011, though the July values reflected the contributions of high air temperature and solar radiation.

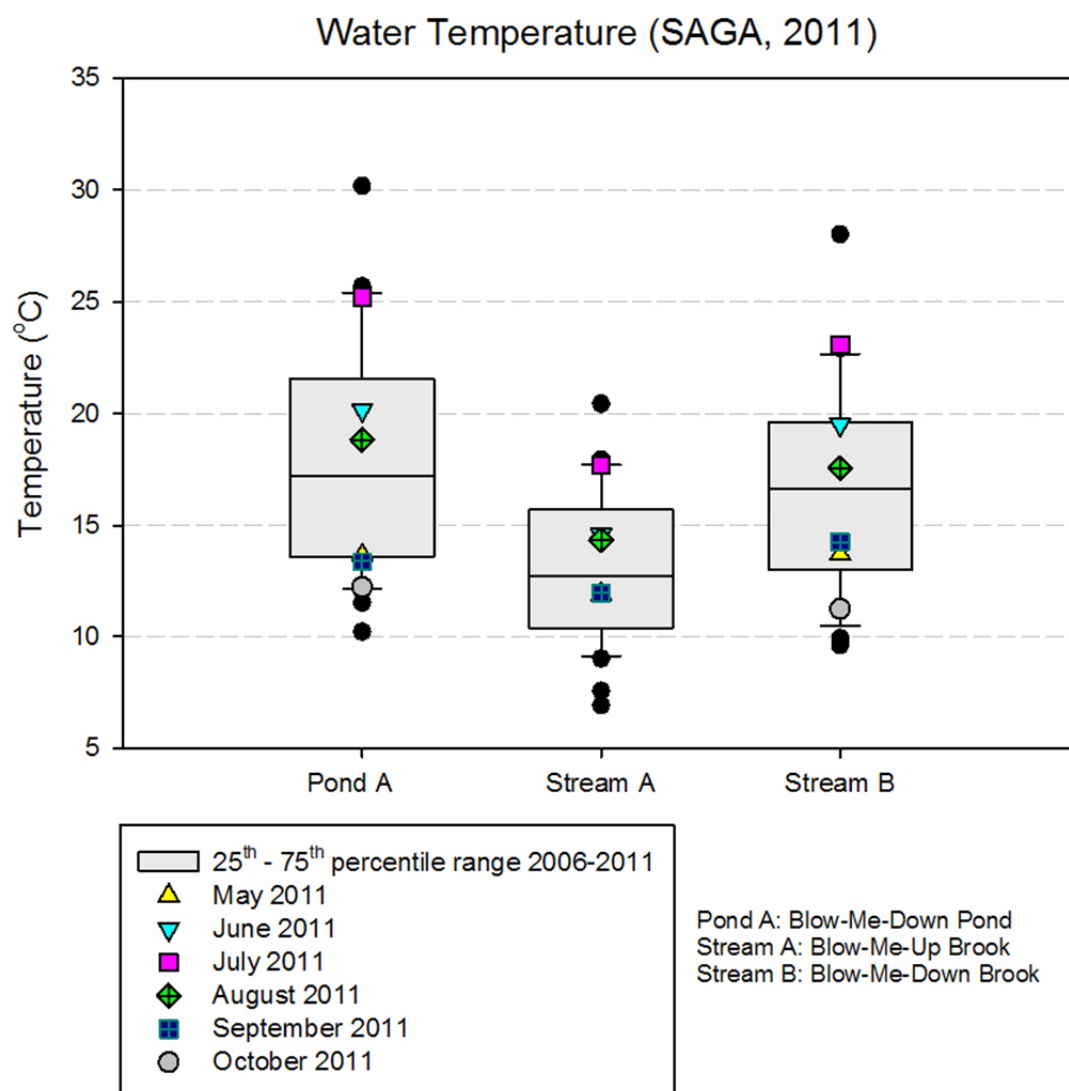


Figure 5. Water temperature (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Dissolved Oxygen

Dissolved oxygen (DO) is a critical indicator of water quality because aquatic life generally needs DO concentrations at or above 5 mg/L to thrive. Low oxygen can directly kill or stress organisms such that they will not be able to successfully reproduce or grow. Water with less than 1 part per million (ppm) of oxygen is considered anoxic (no oxygen present). All SAGA sites were well oxygenated in 2011 (Figure 6) and were well above the more stringent (6 mg/L) state stream DO standard.

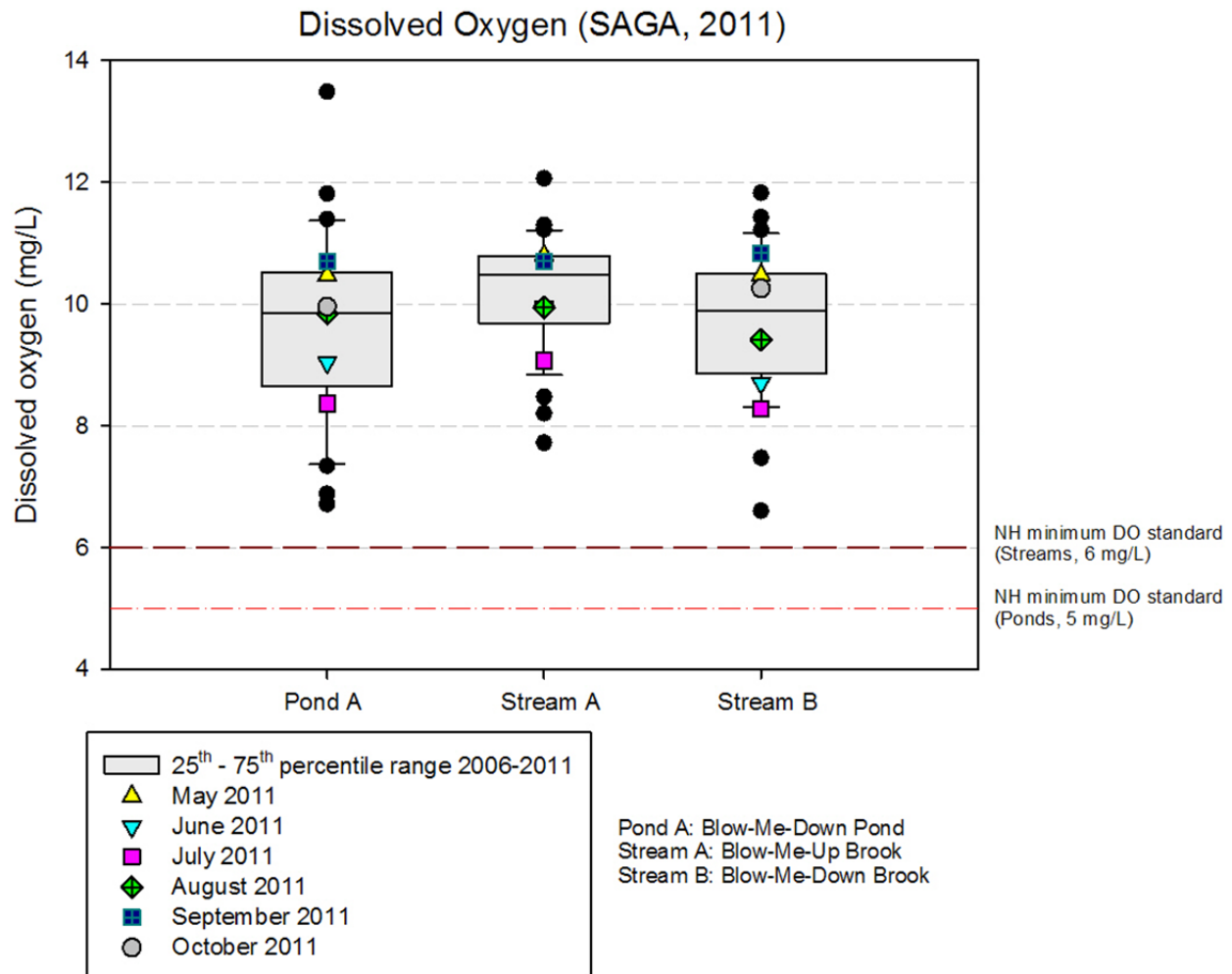


Figure 6. Dissolved oxygen (surface) from 2011 YSI sonde in-situ measurements overlaid on a box plot of measurements taken from 2006-2011.

Acid Neutralizing Capacity

Acid neutralizing capacity (ANC) is also known as alkalinity, or buffering capacity. It is due primarily to the presence of naturally available bicarbonate, carbonate, and hydroxide ions, with bicarbonate being the major form. Most states do not have numerical criteria for ANC in their water-quality standards. ANC values greater than 100 $\mu\text{eq/L}$ are considered well-buffered, while values less than zero typify acidic waters (Stoddard et al. 2003). Acid neutralizing capacity measured in the 2011 samples (Figure 7) illustrates that the SAGA pond and streams were well-buffered, likely due to the underlying geology. In the streams, May (spring) 2011 ANC measurements follow the typical seasonal pattern of being lower than August (summer) values. This is likely due to the contribution of episodic acidification from spring snowmelt and runoff (and also illustrates the ability of the robust ANC to counteract the acidification pulses). Samples from Blow-Me-Down Pond did not show this seasonal pattern.

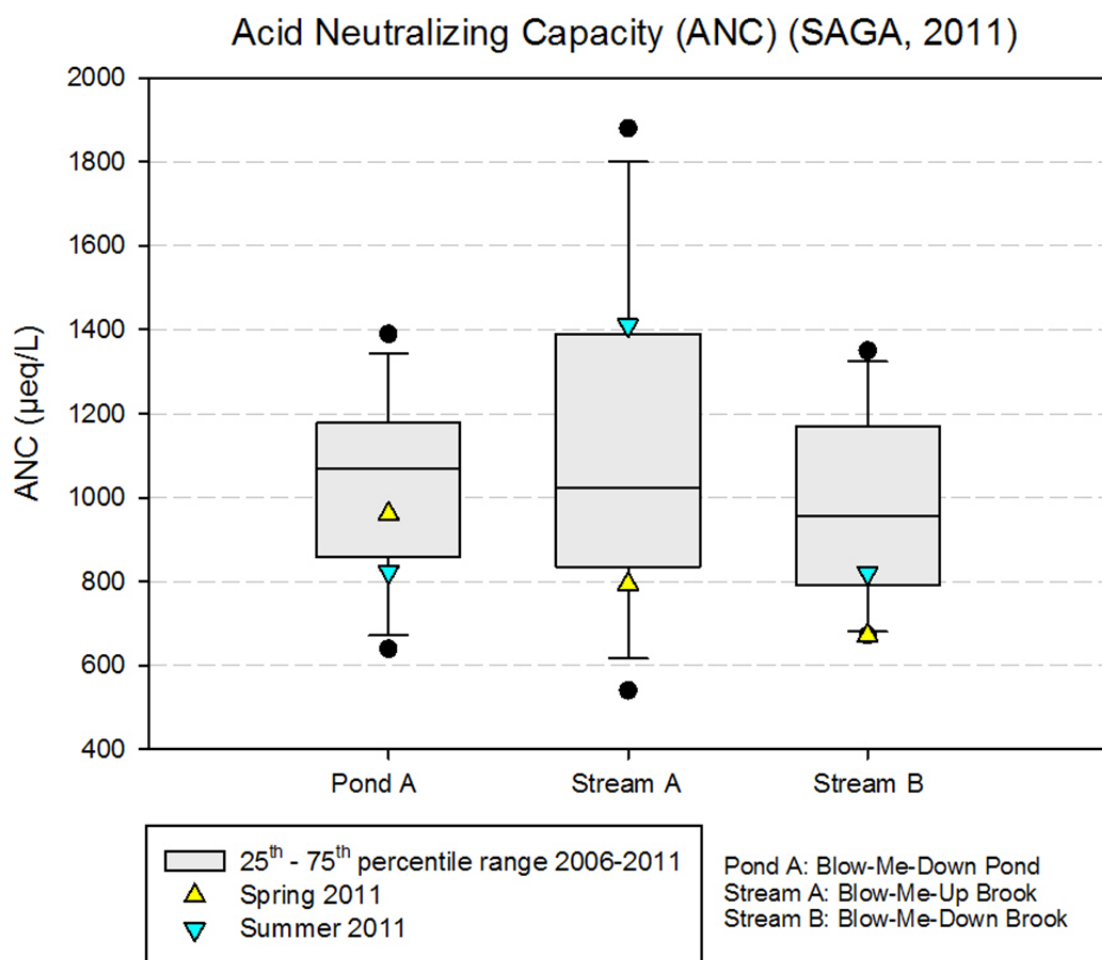


Figure 7. Acid neutralizing capacity from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.

Apparent Color

Color in pond and stream water is caused by natural metallic ions, humus and peat materials, plankton, weeds, and industrial wastes. Color is reported in Pt-Co units (PCU). True color is the color measurement of water from which suspended particles have been removed by filtration. Apparent color (the measurement method utilized by NETN) is determined on original samples without filtration. Color can be a rough indicator for organic acidity.

Water bodies with apparent color values of greater than 25 PCU are considered to be highly colored, and often exhibit reduced water clarity and high phosphorus concentrations. Values of color are usually not included in water quality standards, except to note that they should be as naturally occurs.

Color values from Blow-Me-Up-Brook (Stream A) were low, both in 2011 samples and in the 2006 to 2011 historic data (Figure 8). Blow-Me-Down-Brook (Stream B) and Blow-Me-Down-Pond (Pond A) were highly colored and historic measurements were more variable. This could be the effect of runoff and sediment input to the systems, rather than dissolved constituents, since the samples were not filtered before analysis. Monthly turbidity measurements, which will begin in 2012, may provide additional information on the impacts to SAGA streams from episodic runoff events.

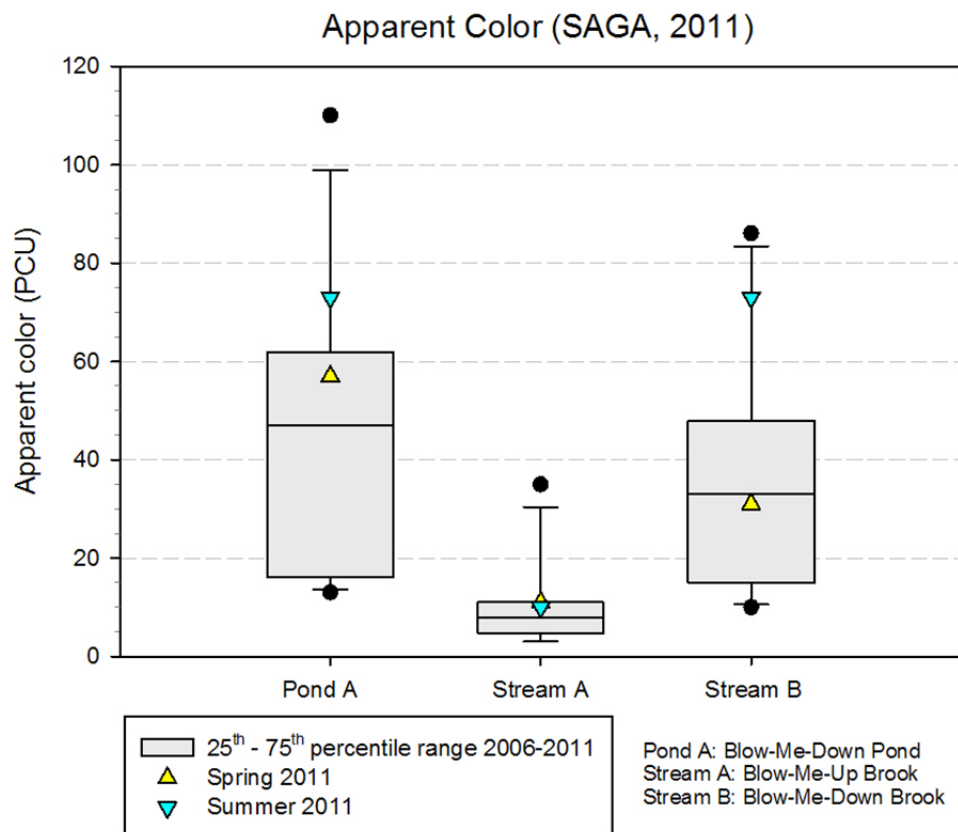


Figure 8. Apparent color from 2011 spring and summer water samples overlaid on a box plot of measurements taken from 2006-2011.

Nutrient Enrichment

Nutrient enrichment and the acceleration of eutrophication have been identified in most NETN parks as one of the stressors of greatest concern. Several forms of total and dissolved phosphorus and nitrogen are measured to give managers information regarding the trophic status and productivity of freshwater systems.

Transparency

Transparency measurements can provide simple and affordable assessments of pond and lake productivity. Variation in precipitation is one of the major factors contributing to annual shifts in transparency. Often during drier conditions lakes and ponds will become clearer due to lower runoff of nutrient and soil inputs. In contrast, decreased transparency readings can often be attributed to the effects of high levels of spring and fall precipitation, as well as the cumulative effects of a high rainfall year.

It is difficult to obtain transparency measurements with a Secchi disk (Figure 9) in Blow-Me-Down Pond. Due to the water clarity and shallow depth, the disk hit the pond bottom before disappearing from the observer's view in most NETN measurements. In measurements taken with the 120 cm turbidity tube, the small target disk on the bottom of the tube was often still visible through 120 cm of pond water. Transparency data from 2006 through 2011 is listed in Appendix A (Table A4). Beginning in 2012, the NETN will measure light attenuation in ponds using an underwater photocell to provide additional information on the water clarity and trophic characteristics of Blow-Me-Down Pond. Stream turbidity will also be measured in the field with an electronic meter.



Figure 9. Secchi disk, measuring tape, and viewing scope (left) and view of submerged Secchi disk through viewing scope (right).

Phosphorus

Phosphorus (P) is one of the major nutrients needed for plant growth. It is generally present in small amounts and limits the plant growth in streams and ponds. Several forms of phosphorus were tested individually. Total phosphorus (TP) is a measure of both inorganic and organic forms of phosphorus, and is the common water quality standard or criteria metric. Phosphorus can be present as dissolved or particulate matter, and filtered samples were analyzed for total dissolved phosphorus (TDP). Soluble reactive phosphorus (SRP, or “orthophosphate”) is a measure of the inorganic oxidized form of soluble phosphorus. This form of phosphorus is the most readily available for uptake during photosynthesis. High concentrations of SRP generally occur in conjunction with algal blooms.

In 2011, most total phosphorus concentrations (Figure 10) were in the moderate range, and showed the expected seasonal variation of lower spring values. The elevated August (summer) TP values in Blow-Me-Down-Brook (Stream B) and Blow-Me-Down-Pond (Pond A) indicate the possibility of substantial runoff and sediment input to the water prior to the monitoring visit. All TP values were near above the EPA Ecoregion 8 criteria of 10 µg/L and 8 µg/L for streams and ponds, respectively. As described above (“Water Quality Standards”), the EPA criteria do not have any regulatory meaning. TDP and SRP levels were generally low.

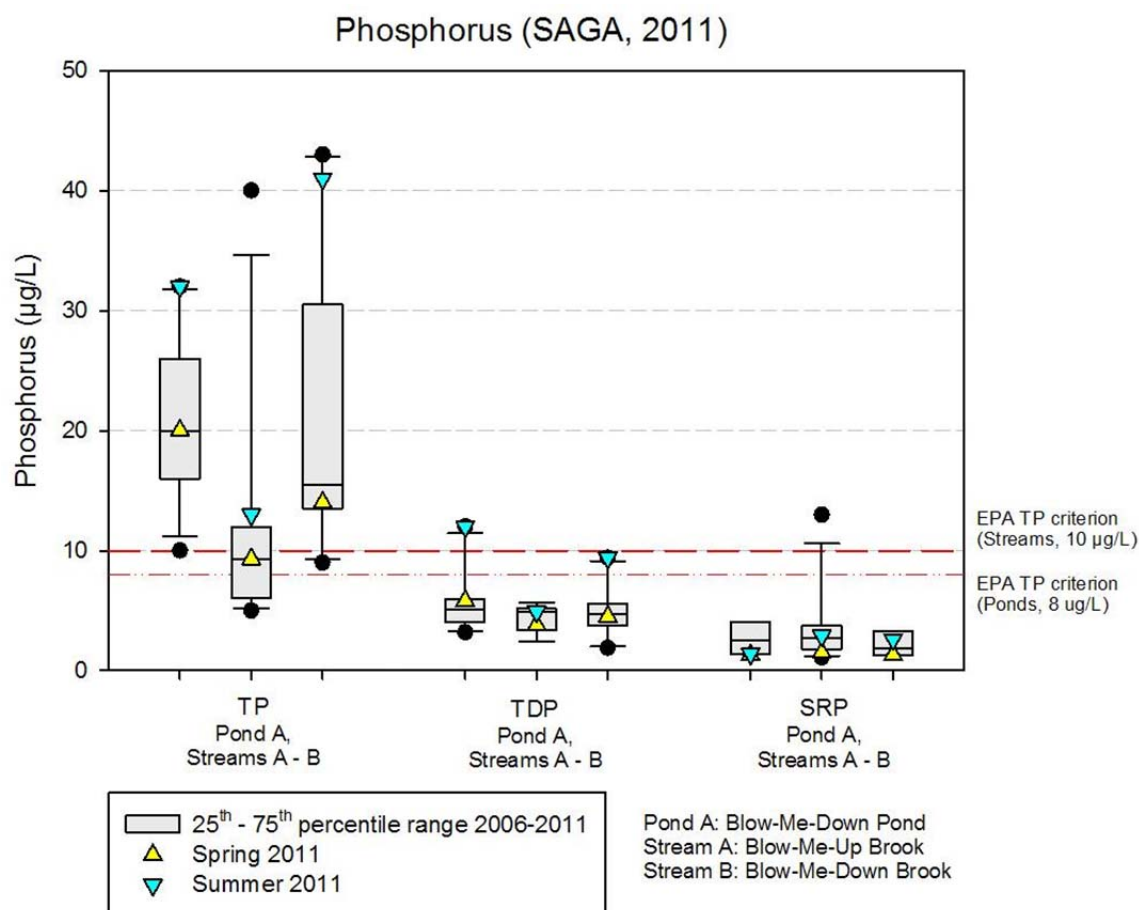


Figure 10. Total phosphorus (TP), total dissolved phosphorus (TDP), and soluble reactive phosphorus (SRP) from spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011. There is no numeric New Hampshire state water quality TP standard.

Nitrogen

Total nitrogen (TN) is a measure of all forms of nitrogen (organic and inorganic). Nitrogen is an essential plant element and is often the limiting nutrient in marine waters, and it can also limit some freshwater systems. Filtered samples were analyzed for total dissolved nitrogen (TDN). The importance of nitrogen in the aquatic environment varies according to the relative amounts of the forms of nitrogen present, including nitrate, nitrite, and ammonia.

Test results for several forms of nitrogen are shown in Figure 11. All TN measurements were in the low range. The August TN value for Blow-Me-Down Brook and both values for Blow-Me-Down Pond exceeded the EPA Ecoregion 8 criterion of 0.38 mg/L (for streams) and 0.24 mg/L (for ponds), although as with TP this criterion does not have regulatory meaning. Both 2011 TN measurements from Blow-Me-Up Brook (Stream A) were below the EPA Ecoregion 8 criterion for streams. Nitrate (NO_3) is the most oxidized and stable form of nitrogen in a water body, and is the primary form of nitrogen used by plants as a nutrient. Nitrite (NO_2) is an unstable form of nitrogen that is either rapidly oxidized to nitrate (nitrification) or reduced to nitrogen gas (denitrification). This form of nitrogen can also be used as a source of nutrients for plants. NETN water samples were analyzed with a combined test for nitrate and nitrite, and results were within the historic range of variability. Nitrite concentrations were very low, with all 2011 test results below the method reporting limit of 0.005 mg/L. All 2011 ammonia (NH_3 , another inorganic, bioavailable form of concern) test results were below the method reporting limit of 0.08 mg/L.

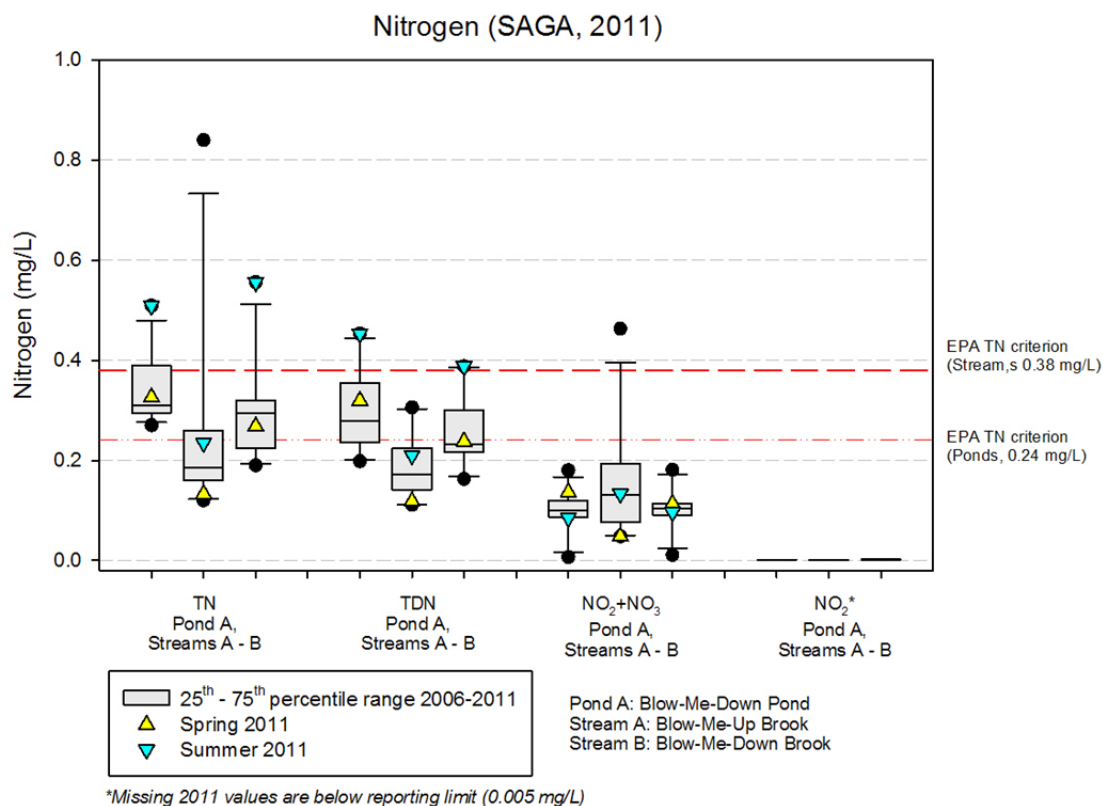


Figure 11. Total nitrogen (TN), total dissolved nitrogen (TDN), nitrite + nitrate ($\text{NO}_2 + \text{NO}_3$), and nitrite (NO_2) from 2011 spring and summer water samples. The data are overlaid on a box plot of measurements taken from 2006-2011.

Water Quantity

Monthly stream discharge measurements, taken with a current meter and wading rod, can be used to calculate loading of nutrient chemical constituents (flow times concentration), and also provide a record of variations in stream flow. Stream stage (height of water) measurements can be paired with discharge values and over time a stage to discharge relationship can be calculated. Once this relationship is established, investigators can interpolate the stream discharge from the stage measurement alone. Numerous discharge measurements at all ranges of streamflow are required to establish and maintain an accurate stage to discharge relationship. Streamflow in 2011 followed the expected seasonal sequence of high discharge in May to minimal flow in July and August, with gradual recovery in September and October. NETN staff are currently reviewing discharge and stage measurement methodology and quality assurance/quality control procedures in order to enhance the quality and utility of the water quantity data. A stage to discharge relationship graph will be produced once sufficient data are collected.

Stream and pond stage measurements were taken by measuring to the water surface from a fixed datum point. Stage measurements from 2011 are graphed in Figure 12. Discharge and stage measurements from 2006 to 2011 are listed in Table A3 in Appendix A.

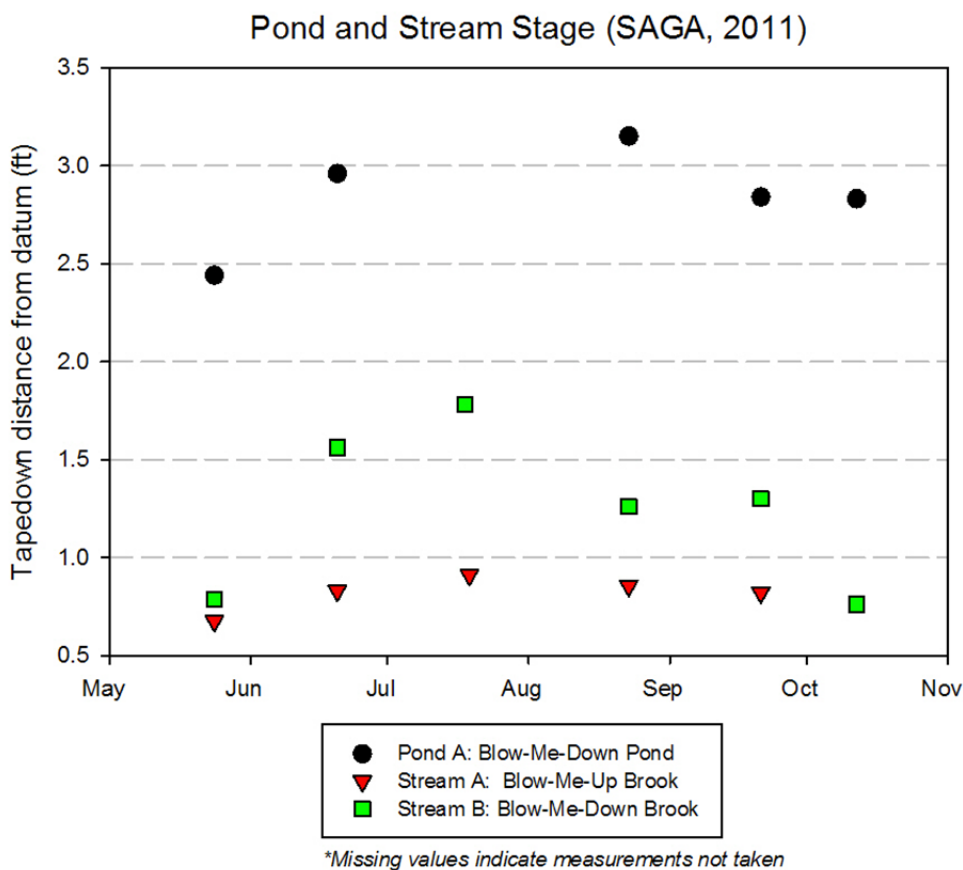


Figure 12. Pond and stream stage obtained in 2011 by measuring from a permanent datum point down to the water surface. *Note: Larger tapedown distances indicate LOWER water levels.*

Invasive Aquatic Plants

NETN's methods for invasive aquatic plant monitoring were adapted from the Maine Center for Invasive Aquatic Plants (MCIAP), a division of the Maine Volunteer Lake Monitoring Program (VLMP). Investigators utilize a level 3 survey, which involves surveying the entire shoreline and transects covering the littoral zone. Detailed survey instructions can be found in the NETN protocol (Lombard et al. 2006).

The primary targets of the invasive plant surveys were the 11 plants currently listed by the MCIAP (Table 4). Surveyors also looked for species on a secondary list (Table 5), compiled from the USGS Nonindigenous Aquatic Species website (<http://nas3.er.usgs.gov/>). The database was queried to obtain species of concern for each of the states containing NETN park units. This list includes some species that have not been located in some states in which NETN monitors (CT, NH, VT), but are of regional concern. The New Hampshire Department of Environmental Services (NHDES) specifically targets all species listed in Table 4 as well as the species in bold type in Table 5 as prohibited exotic species in the state. Common reed (*Phragmites australis*) is also listed on the NHDES "Frightful Fourteen" list of priority invasive aquatic species (http://des.nh.gov/organization/commissioner/pip/publications/wd/documents/frightful_fourteen.pdf).

Invasive aquatic plant monitoring was conducted at the Blow-Me-Down Pond during the 2011 monitoring season. Results indicated that invasive aquatic plants do not currently exist at the Blow-Me-Down Pond.

During future visits to all NETN parks, monitors will be increasingly attentive for the presence of Didymo (*Didymosphenia geminata*), also known as "rock snot", a highly invasive alga that has recently invaded the northern reaches of the Connecticut River in New Hampshire and in the White River and Battenkill River in Vermont. This species has a great potential to alter habitats and displace native species, and is of great concern to officials in regions where infestations have been established.

Table 4. Maine Center for Invasive Aquatic Plants species of concern.

Common name	Latin name
European Frogbit	<i>Hydrocharis morsus-ranae</i>
Water Chestnut	<i>Trapa natans</i>
Yellow Floating Heart	<i>Nymphoides peltata</i>
Eurasian Water Milfoil	<i>Myriophyllum spicatum</i>
Variable Water Milfoil	<i>Myriophyllum heterophyllum</i>
Parrot Feather	<i>Myriophyllum aquaticum</i>
Fanwort	<i>Cabomba caroliniana</i>
Hydrilla	<i>Hydrilla verticillata</i>
Brazilian Elodea	<i>Egeria densa</i>
European Naiad	<i>Najas minor</i>
Curly-Leaved Pondweed	<i>Potamogeton crispus</i>

Table 5. U.S. Geological Survey Nonindigenous Aquatic Species of concern.

Common name	Latin name	State(s) listed
Flowering Rush	<i>Butomus umbellatus</i>	NY,NH,CT,VT
Pond water-starwort	<i>Callitriche stagnalis</i>	NY,CT, MA
Water Hyacinth	<i>Eichhornia crassipes</i>	NY
Yellow Iris	<i>Iris pseudacorus</i>	NY, NH, VT, MA, CT
Dotted Duckweed	<i>Landoltia salicaria</i>	MA
Water Primrose	<i>Ludwigia hexapetala</i>	NY
Purple Loosestrife	<i>Lythrum salicaria</i>	NY, MA, CT, NH, VT
European Water-clover	<i>Marsilea quadrifolia</i>	NY, CT
Water-cress	<i>Nasturtium officinale</i>	NY, CT, NH, VT, MA
Sacred Lotus	<i>Nelumba nucifera</i>	NY
Water Lettuce	<i>Pistia straitotes</i>	NY
Amphibious Yellow-cress	<i>Rorippa amphibia</i>	NY, CT, VT

Didymo is easily spread by even just one cell of the alga breaking off and drifting downstream in infested reaches. It is also very easily spread by waders and potentially water monitoring equipment and other gear that touches the bottoms of streams in infested areas. Enhanced equipment cleaning and decontamination procedures are being included in the latest NETN monitoring protocol revision.

Since non-native, invasive plants have recently been detected with increasing frequency in New England lakes and ponds, it has become crucial to closely monitor the status of park waters. The early detection of an infestation can make eradication or control more feasible, and it can lead to efforts that reduce the spread of the plant to neighboring water bodies. Designating the early detection of these plants as a NETN vital sign and the ongoing partnership with state and local monitoring and eradication efforts are highly effective prevention strategies.

Summary

Most 2011 water quality parameters for the pond and streams monitored in Saint-Gaudens National Historical Park are within state standards, and are generally within the range of EPA criteria, where applicable. The majority of values are within the ranges of the historic NETN monitoring data from SAGA. Apparent color and TP measurements from the August (summer) samples from Blow-Me-Down-Brook (Stream B) and Blow-Me-Down-Pond (Pond A) demonstrate the effects of runoff and sediment input on water chemistry.

ANC measurements showed that all sites were very well-buffered, sufficient to avoid severely depressed pH values from episodic acid deposition. Test results for TN, TDN, and NO₃ were relatively low in most 2011 samples. Results for NO₂ were below the method reporting limit of 0.005 mg/L. All ammonia (NH₃) test results were below the method reporting limit of 0.08 mg/L.

Monitoring under the NETN protocol builds on the historic water quality monitoring by park staff and other agencies to provide critical baseline information on the chemical and physical status of the water resources Saint-Gaudens National Historical Park. Several changes will be implemented in the 2012 monitoring season, including taking monthly stream turbidity measurements, and the addition of sulfate, chloride, and dissolved organic carbon (DOC) analyses to the spring and summer water chemistry testing. These changes will expand the scope and usefulness of the monitoring data. As more data are collected, the ability to detect changes outside this natural range of variability will increase, which in turn will more clearly indicate the status of the vital signs of water quality, nutrient enrichment, water quantity, and the detection of invasive plant species.

Literature Cited

- Lombard, P., W. Gawley, J. Caldwell. 2006. Freshwater Vital-Signs Monitoring Plan for National Parks in the Northeast Temperate Network (NETN) PHASE III: Water-Quality Monitoring Protocols in Lakes, Ponds and Streams. USGS, Augusta, Maine, 222 p.
- New Hampshire Department of Environmental Services, 1999, State of New Hampshire surface water-quality regulations, Chapter 1700: accessed on March 23, 2012 at:
<http://des.nh.gov/organization/commissioner/legal/rules/documents/env-wq1700.pdf>
- Rantz, S.E., et al, 1982, Measurements and computation of streamflow, volumes 1 and 2: U.S. Geological Survey Water-Supply Paper 2175, 631 p.
- Stoddard, J., J. S. Kahl, F. Deviney, D. DeWalle, C. Driscoll, A. Herlihy, J. Kellogg, P. Murdoch, J. Webb, and K. Webster. 2003. Response of surface-water chemistry to the Clean Air Act Amendments of 1990. U.S. Environmental Protection Agency USEPA/620/R-03/001, Washington, DC, 78 p.
- U.S. Environmental Protection Agency. 2000a. Nutrient Criteria Technical Guidance Manual, Lakes and Reservoirs. First Edition. EPA-822-B00-001, April 2000.
- U.S. Environmental Protection Agency. 2000b. Nutrient Criteria Technical Guidance Manual, Rivers and Streams. First Edition. EPA-822-B00-002, July 2000.
- U.S. Environmental Protection Agency. 2002. Ecoregional nutrient criteria. U.S. Environmental Protection Agency Fact Sheet USEPA-822-F-02-008, October 2002.
- Walasewicz, 2003 Water resources monitoring Saint-Gaudens National Historical Site annual report: National Park Service, 22 p.

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011.

Table A1. YSI sonde in-situ water quality measurements collected at SAGA.

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (μ S/cm)
Blow-Me-Down Pond	6/13/2006	0.0	14.85	10.11	7.84	98
Blow-Me-Down Pond	6/13/2006	1.0	14.67	10.11	7.81	97
Blow-Me-Down Pond	7/20/2006	0.0	22.54	8.93	8.07	146
Blow-Me-Down Pond	7/20/2006	1.0	21.23	9.11	7.90	146
Blow-Me-Down Pond	7/20/2006	1.6	21.19	9.10	7.83	146
Blow-Me-Down Pond	8/17/2006	0.0	22.98	9.98	8.07	166
Blow-Me-Down Pond	8/17/2006	1.0	19.81	8.97	7.87	167
Blow-Me-Down Pond	9/14/2006	0.0	14.82	9.72	8.05	187
Blow-Me-Down Pond	9/14/2006	1.0	14.01	10.06	7.94	184
Blow-Me-Down Pond	10/11/2006	0.0	11.50	9.90	8.01	166
Blow-Me-Down Pond	10/11/2006	1.0	11.47	9.75	7.90	167
Blow-Me-Down Pond	5/8/2007	0.0	12.22	11.35	7.69	122
Blow-Me-Down Pond	5/8/2007	1.0	11.31	11.47	7.70	124
Blow-Me-Down Pond	5/8/2007	1.5	11.26	11.49	7.71	125
Blow-Me-Down Pond	6/7/2007	0.0	13.94	10.47	7.84	119
Blow-Me-Down Pond	6/7/2007	1.0	13.41	10.48	7.83	114
Blow-Me-Down Pond	6/7/2007	1.6	13.35	10.46	7.81	119
Blow-Me-Down Pond	7/2/2007	0.0	19.51	8.58	7.82	180
Blow-Me-Down Pond	7/2/2007	1.0	17.90	8.28	7.71	180
Blow-Me-Down Pond	7/2/2007	1.3	17.75	8.24	7.65	180
Blow-Me-Down Pond	8/14/2007	0.0	20.46	6.71	7.75	188
Blow-Me-Down Pond	8/14/2007	1.0	20.25	6.88	7.71	188
Blow-Me-Down Pond	8/14/2007	1.4	20.12	6.33	7.68	188
Blow-Me-Down Pond	9/11/2007	0.1	18.39	6.88	7.79	199
Blow-Me-Down Pond	9/11/2007	1.0	18.22	6.95	7.72	200
Blow-Me-Down Pond	9/11/2007	1.5	18.22	6.69	7.66	200
Blow-Me-Down Pond	10/12/2007	0.0	13.40	9.68	7.97	168
Blow-Me-Down Pond	10/12/2007	1.0	13.38	9.41	7.84	167
Blow-Me-Down Pond	10/12/2007	1.3	13.42	8.43	7.76	168
Blow-Me-Down Pond	5/19/2008	0.0	12.02	10.81	7.95	138
Blow-Me-Down Pond	5/19/2008	1.0	12.03	10.83	8.02	138
Blow-Me-Down Pond	5/19/2008	1.5	12.02	10.81	8.03	138
Blow-Me-Down Pond	6/16/2008	0.0	23.59	13.48	9.27	187
Blow-Me-Down Pond	6/16/2008	1.0	21.48	9.44	7.98	188
Blow-Me-Down Pond	6/16/2008	1.3	20.70	8.72	7.82	189
Blow-Me-Down Pond	7/21/2008	0.0	22.29	9.47	7.89	184
Blow-Me-Down Pond	7/21/2008	1.0	21.64	9.03	7.80	184
Blow-Me-Down Pond	7/21/2008	1.5	21.45	7.81	7.58	183

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at SAGA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (µS/cm)
Blow-Me-Down Pond	8/22/2008	0.0	17.24	8.79	7.75	169
Blow-Me-Down Pond	8/22/2008	1.0	17.16	8.76	7.54	168
Blow-Me-Down Pond	8/22/2008	1.3	17.08	8.84	7.58	168
Blow-Me-Down Pond	9/23/2008	0.0	16.26	11.39	8.04	181
Blow-Me-Down Pond	9/23/2008	1.0	13.43	10.30	7.91	181
Blow-Me-Down Pond	9/23/2008	1.4	13.19	10.59	7.88	181
Blow-Me-Down Pond	10/13/2008	0.0	12.73	10.64	7.78	178
Blow-Me-Down Pond	10/13/2008	1.0	11.03	10.39	7.80	179
Blow-Me-Down Pond	10/13/2008	1.3	10.78	10.88	7.89	178
Blow-Me-Down Pond	5/7/2009	0.0	13.65	10.51	7.71	134
Blow-Me-Down Pond	5/7/2009	1.0	13.50	10.44	7.71	133
Blow-Me-Down Pond	5/7/2009	1.3	13.50	10.40	7.70	134
Blow-Me-Down Pond	6/18/2009	0.0	17.54	8.34	7.48	158
Blow-Me-Down Pond	6/18/2009	1.0	17.37	8.59	7.45	158
Blow-Me-Down Pond	6/18/2009	1.3	17.34	8.50	7.45	158
Blow-Me-Down Pond	7/21/2009	0.0	20.54	10.03	7.57	151
Blow-Me-Down Pond	7/21/2009	1.0	19.97	9.82	7.55	151
Blow-Me-Down Pond	7/21/2009	1.6	19.59	8.77	7.51	153
Blow-Me-Down Pond	8/20/2009	0.0	25.69	9.58	7.88	175
Blow-Me-Down Pond	8/20/2009	1.0	22.72	8.56	7.55	175
Blow-Me-Down Pond	8/20/2009	1.5	22.13	7.50	7.45	175
Blow-Me-Down Pond	9/30/2009	0.0	13.75	10.42	7.64	172
Blow-Me-Down Pond	9/30/2009	0.0	13.79	10.85	7.49	172
Blow-Me-Down Pond	9/30/2009	1.0	13.71	10.45	7.65	172
Blow-Me-Down Pond	9/30/2009	1.0	13.79	10.85	7.47	173
Blow-Me-Down Pond	9/30/2009	1.2	13.74	10.22	7.64	172
Blow-Me-Down Pond	9/30/2009	1.4	13.78	10.81	7.44	173
Blow-Me-Down Pond	10/22/2009	0.0	10.20	11.81	7.87	166
Blow-Me-Down Pond	10/22/2009	1.0	9.72	11.82	7.90	165
Blow-Me-Down Pond	10/22/2009	1.2	9.62	11.94	7.93	165
Blow-Me-Down Pond	5/25/2010	0.0	19.10	7.38	7.44	141
Blow-Me-Down Pond	5/25/2010	1.0	18.94	7.33	7.43	141
Blow-Me-Down Pond	5/25/2010	1.3	18.93	7.24	7.41	141
Blow-Me-Down Pond	6/15/2010	0.0	15.94	8.65	7.79	160
Blow-Me-Down Pond	6/15/2010	1.0	15.63	8.61	7.81	161
Blow-Me-Down Pond	6/15/2010	1.4	15.60	8.39	7.83	161
Blow-Me-Down Pond	7/8/2010	0.0	30.17	8.37	7.82	199
Blow-Me-Down Pond	7/8/2010	1.0	23.56	5.37	7.28	195
Blow-Me-Down Pond	7/8/2010	1.1	22.91	4.09	7.27	196
Blow-Me-Down Pond	8/11/2010	0.0	25.68	7.34	6.98	216
Blow-Me-Down Pond	8/11/2010	1.0	21.72	3.88	6.66	216

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at SAGA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (µS/cm)
Blow-Me-Down Pond	8/11/2010	1.3	20.88	1.11	6.61	220
Blow-Me-Down Pond	9/8/2010	0.0	21.57	9.75	7.57	234
Blow-Me-Down Pond	9/8/2010	1.0	19.20	5.74	7.39	234
Blow-Me-Down Pond	9/8/2010	1.3	18.92	5.00	7.41	234
Blow-Me-Down Pond	10/4/2010	0.0	13.54	10.52	7.52	159
Blow-Me-Down Pond	10/4/2010	1.0	13.36	10.64	7.52	159
Blow-Me-Down Pond	10/4/2010	1.3	12.69	11.14	7.53	156
Blow-Me-Down Pond	5/23/2011	0.0	13.65	10.46	7.77	104
Blow-Me-Down Pond	5/23/2011	1.0	13.65	10.47	7.76	104
Blow-Me-Down Pond	5/23/2011	1.5	13.62	10.45	7.77	104
Blow-Me-Down Pond	6/21/2011	0.0	20.16	9.04	7.62	149
Blow-Me-Down Pond	6/21/2011	1.0	18.30	8.44	7.55	148
Blow-Me-Down Pond	6/21/2011	1.4	18.20	8.26	7.51	148
Blow-Me-Down Pond	7/19/2011	0.0	25.22	8.36	7.69	176
Blow-Me-Down Pond	7/19/2011	0.0	24.88	7.93	7.59	176
Blow-Me-Down Pond	7/19/2011	1.0	22.55	6.43	7.37	178
Blow-Me-Down Pond	7/19/2011	1.0	22.12	6.07	7.40	179
Blow-Me-Down Pond	7/19/2011	1.2	21.94	5.54	7.30	179
Blow-Me-Down Pond	7/19/2011	1.4	21.56	2.09	7.11	192
Blow-Me-Down Pond	8/23/2011	0.0	18.83	9.84	7.78	134
Blow-Me-Down Pond	8/23/2011	1.0	18.40	9.70	7.73	133
Blow-Me-Down Pond	8/23/2011	1.6	18.42	9.65	7.72	134
Blow-Me-Down Pond	9/21/2011	0.0	13.36	10.70	7.01	145
Blow-Me-Down Pond	9/21/2011	1.0	13.31	10.76	7.00	145
Blow-Me-Down Pond	9/21/2011	1.4	13.22	10.77	7.05	146
Blow-Me-Down Pond	10/12/2011	0.0	12.20	9.95	7.88	130
Blow-Me-Down Pond	10/12/2011	1.0	12.15	9.95	7.84	130
Blow-Me-Down Pond	10/12/2011	1.4	12.15	9.79	7.84	130
Blow-Me-Up Brook (Stream A)	5/16/2006	0.4	9.18	11.17	7.83	84
Blow-Me-Up Brook (Stream A)	6/13/2006	0.0	11.65	10.67	7.89	99
Blow-Me-Up Brook (Stream A)	7/20/2006	0.2	16.46	9.68	8.18	124
Blow-Me-Up Brook (Stream A)	8/17/2006	0.2	15.35	9.75	8.59	144
Blow-Me-Up Brook (Stream A)	9/14/2006	0.0	12.41	10.18	8.04	164
Blow-Me-Up Brook (Stream A)	10/11/2006	0.1	10.25	10.76	8.39	116
Blow-Me-Up Brook (Stream A)	4/4/2007	0.0	1.42	13.76	8.11	91
Blow-Me-Up Brook (Stream A)	5/8/2007	0.5	6.90	12.06	8.10	101
Blow-Me-Up Brook (Stream A)	6/7/2007	0.0	9.47	11.22	8.06	120
Blow-Me-Up Brook (Stream A)	7/2/2007	0.3	12.69	10.55	8.21	146
Blow-Me-Up Brook (Stream A)	8/14/2007	0.0	13.93	9.80	8.55	177
Blow-Me-Up Brook (Stream A)	9/11/2007	0.2	15.44	9.66	8.03	190
Blow-Me-Up Brook (Stream A)	10/12/2007	0.3	12.28	10.10	8.16	168

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at SAGA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (µS/cm)
Blow-Me-Up Brook (Stream A)	5/20/2008	0.2	7.56	11.29	8.00	107
Blow-Me-Up Brook (Stream A)	6/16/2008	-0.1	15.83	9.20	7.82	148
Blow-Me-Up Brook (Stream A)	6/16/2008	-0.1	15.84	9.30	7.79	148
Blow-Me-Up Brook (Stream A)	7/22/2008	0.0	16.89	9.12	7.83	159
Blow-Me-Up Brook (Stream A)	8/22/2008	0.4	13.93	10.19	7.99	151
Blow-Me-Up Brook (Stream A)	9/24/2008	0.1	10.37	10.74	7.94	161
Blow-Me-Up Brook (Stream A)	10/13/2008	0.4	9.59	10.95	7.98	171
Blow-Me-Up Brook (Stream A)	5/7/2009	0.3	10.75	10.91	7.89	109
Blow-Me-Up Brook (Stream A)	6/18/2009	0.1	12.27	10.55	7.91	137
Blow-Me-Up Brook (Stream A)	7/21/2009	0.3	15.70	10.72	7.84	142
Blow-Me-Up Brook (Stream A)	8/20/2009	0.1	17.94	9.16	7.85	154
Blow-Me-Up Brook (Stream A)	10/1/2009	0.1	9.00	10.98	7.91	151
Blow-Me-Up Brook (Stream A)	10/22/2009	0.3	9.19	11.20	8.18	144
Blow-Me-Up Brook (Stream A)	5/25/2010	0.2	13.33	10.48	7.53	125
Blow-Me-Up Brook (Stream A)	6/14/2010	0.0	13.94	10.29	8.10	139
Blow-Me-Up Brook (Stream A)	7/8/2010	0.0	20.36	8.90	7.96	170
Blow-Me-Up Brook (Stream A)	7/8/2010	0.0	20.43	8.47	8.02	168
Blow-Me-Up Brook (Stream A)	8/11/2010	0.1	17.74	8.20	7.27	204
Blow-Me-Up Brook (Stream A)	9/8/2010	0.3	17.38	7.72	7.85	234
Blow-Me-Up Brook (Stream A)	10/5/2010	-0.1	11.69	10.47	7.78	191
Blow-Me-Up Brook (Stream A)	5/24/2011	-0.1	11.86	10.79	7.83	95
Blow-Me-Up Brook (Stream A)	6/20/2011	0.1	14.58	9.95	7.81	127
Blow-Me-Up Brook (Stream A)	7/19/2011	0.1	17.68	9.07	7.87	150
Blow-Me-Up Brook (Stream A)	8/23/2011	0.2	14.35	9.94	7.98	151
Blow-Me-Up Brook (Stream A)	9/21/2011	0.1	11.93	10.70	7.72	118
Blow-Me-Down Brook (Stream B)	6/13/2006	0.3	13.82	10.23	7.95	96
Blow-Me-Down Brook (Stream B)	7/20/2006	0.3	19.94	9.07	7.92	145
Blow-Me-Down Brook (Stream B)	8/17/2006	0.2	19.67	9.39	8.05	163
Blow-Me-Down Brook (Stream B)	9/14/2006	0.0	14.29	10.34	7.96	186
Blow-Me-Down Brook (Stream B)	10/11/2006	0.1	11.45	10.77	7.91	166
Blow-Me-Down Brook (Stream B)	4/4/2007	0.1	2.17	13.50	7.96	87
Blow-Me-Down Brook (Stream B)	5/8/2007	0.6	9.92	11.42	7.86	122
Blow-Me-Down Brook (Stream B)	6/7/2007	0.1	12.03	10.62	8.03	117
Blow-Me-Down Brook (Stream B)	7/2/2007	0.3	17.91	9.47	8.01	170
Blow-Me-Down Brook (Stream B)	8/14/2007	0.0	18.61	8.38	8.11	187
Blow-Me-Down Brook (Stream B)	9/11/2007	0.3	17.99	8.97	7.89	200
Blow-Me-Down Brook (Stream B)	10/12/2007	0.3	13.21	9.98	7.99	160
Blow-Me-Down Brook (Stream B)	5/20/2008	0.1	9.69	11.12	7.84	135
Blow-Me-Down Brook (Stream B)	6/16/2008	0.0	21.36	8.32	7.91	190
Blow-Me-Down Brook (Stream B)	7/21/2008	0.2	21.25	8.85	7.94	186
Blow-Me-Down Brook (Stream B)	8/22/2008	0.5	16.63	9.89	7.94	167

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A1. YSI sonde in-situ water quality measurements collected at SAGA (continued).

Site	Date	Depth (m)	Temp (C)	DO (mg/L)	pH	Specific Conductance (µS/cm)
Blow-Me-Down Brook (Stream B)	9/24/2008	0.1	13.12	10.27	7.88	183
Blow-Me-Down Brook (Stream B)	10/13/2008	0.4	10.82	11.21	8.00	155
Blow-Me-Down Brook (Stream B)	5/7/2009	0.5	13.17	10.49	7.93	135
Blow-Me-Down Brook (Stream B)	6/18/2009	0.3	16.33	9.67	7.83	156
Blow-Me-Down Brook (Stream B)	7/21/2009	0.6	19.63	9.95	7.87	147
Blow-Me-Down Brook (Stream B)	8/20/2009	0.2	22.49	8.78	7.97	174
Blow-Me-Down Brook (Stream B)	10/1/2009	0.2	10.83	10.63	7.96	176
Blow-Me-Down Brook (Stream B)	10/22/2009	0.3	9.59	11.82	8.13	164
Blow-Me-Down Brook (Stream B)	5/25/2010	0.0	19.30	10.06	7.89	138
Blow-Me-Down Brook (Stream B)	5/25/2010	0.0	19.39	9.58	7.89	138
Blow-Me-Down Brook (Stream B)	6/14/2010	0.0	17.00	9.82	8.14	158
Blow-Me-Down Brook (Stream B)	7/8/2010	0.4	28.01	8.61	8.31	196
Blow-Me-Down Brook (Stream B)	8/11/2010	0.1	22.92	7.47	7.21	211
Blow-Me-Down Brook (Stream B)	9/8/2010	0.4	19.30	6.60	7.61	239
Blow-Me-Down Brook (Stream B)	10/4/2010	0.2	13.00	10.25	7.51	162
Blow-Me-Down Brook (Stream B)	5/24/2011	0.1	13.68	10.47	7.83	104
Blow-Me-Down Brook (Stream B)	6/20/2011	0.3	19.52	8.70	7.86	147
Blow-Me-Down Brook (Stream B)	7/18/2011	0.2	23.08	8.28	7.91	173
Blow-Me-Down Brook (Stream B)	8/23/2011	0.3	17.56	9.41	7.88	133
Blow-Me-Down Brook (Stream B)	9/21/2011	0.0	14.26	10.83	7.74	142
Blow-Me-Down Brook (Stream B)	10/12/2011	0.3	11.22	10.25	7.93	121

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for SAGA. “<MRL” indicates the result was below the method reporting limit (provided after the abbreviation). *Missing values indicate data are unavailable.*

Site	Date	ANC (µeq/L)	Apparent Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO ₂ +NO ₃ (mg/L)	NO ₂ (mg/L)	NH ₃ (mg/L)
Blow-Me-Down Pond	6/13/2006	640.0	13	20		4.0	0.300		0.122	<MRL 0.002	0.007
Blow-Me-Down Pond	8/17/2006	1,140.0	15	<MRL 20		4.0	0.270		0.113	0.001	0.015
Blow-Me-Down Pond	6/7/2007	744.9	15	10	5.0	4.0	0.290	0.250	0.109	0.001	0.013
Blow-Me-Down Pond	8/14/2007	1,236.6	20	26	4.0	<MRL 6	0.370	0.230	0.038	0.001	0.037
Blow-Me-Down Pond	6/16/2008	1,107.0	63	17	4.0	<MRL 1	0.294	0.238	0.098	<MRL 0.005	
Blow-Me-Down Pond	8/22/2008	1,060.0	44	16	3.2	<MRL 1	0.410	0.356	0.092	<MRL 0.005	<MRL 0.08
Blow-Me-Down Pond	8/20/2009	1,190.0	58	16	5.3	<MRL 1	0.306	0.253	0.097	<MRL 0.005	<MRL 0.08
Blow-Me-Down Pond	6/18/2009	1,020.0	50	22	5.2	2.5	0.314	0.306	0.100	<MRL 0.005	0.095
Blow-Me-Down Pond	6/15/2010	1,080.0	41	22	4.9	1.4	0.395	0.354	0.180	<MRL 0.005	<MRL 0.08
Blow-Me-Down Pond	8/11/2010	1,390.0	110	31	6.4	<MRL 1	0.298	0.198	0.007	<MRL 0.005	<MRL 0.08
Blow-Me-Down Pond	8/23/2011	823.0	73	32	12.0	1.4	0.509	0.453	0.085	<MRL 0.005	<MRL 0.08
Blow-Me-Down Pond	6/21/2011	961.0	57	20	5.8	1.3	0.326	0.319	0.136	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	6/13/2006	860.0	5	<MRL 20		4.0	0.120		0.054	<MRL 0.002	0.006
Blow-Me-Up Brook (Stream A)	8/17/2006	540.0	35	40		13.0	0.840		0.463	0.002	0.016
Blow-Me-Up Brook (Stream A)	8/14/2007	1,611.8		6	5.0	5.0	0.260	0.270	0.213	<MRL 0.002	<MRL 0.02
Blow-Me-Up Brook (Stream A)	5/8/2007	827.1	3	5	<MRL 6	3.0	0.190	0.170	0.137	0.001	<MRL 0.02
Blow-Me-Up Brook (Stream A)	5/20/2008	895.0	3	8	2.4	1.6	0.186	0.148	0.131	<MRL 0.005	
Blow-Me-Up Brook (Stream A)	8/22/2008	1,250.0	5	12	5.7	2.6	0.161	0.180	0.132	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	5/7/2009	937.0	8	6	2.9	1.1	<MRL 0.1	0.111	0.066	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	8/20/2009	1,330.0	10	12	4.9	3.0	0.160	0.155	0.105	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	5/25/2010	1,110.0	6	6	4.9	2.3	0.171	0.174	0.123	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	8/11/2010	1,880.0	12	10	5.3	2.6	0.303	0.306	0.239	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	5/24/2011	794.0	11	9	3.8	1.5	0.133	0.118	0.048	<MRL 0.005	<MRL 0.08
Blow-Me-Up Brook (Stream A)	8/23/2011	1,410.0	10	13	4.9	2.9	0.235	0.210	0.133	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	8/17/2006	1,120.0	13	<MRL 20		4.0	0.320		0.133	0.001	0.012
Blow-Me-Down Brook (Stream B)	8/14/2007	1,218.3	15	15	4.0	<MRL 6	0.260	0.220	0.079	0.002	0.012
Blow-Me-Down Brook (Stream B)	5/8/2007	715.4	10	12	5.0	<MRL 6	0.340	0.370	0.181	0.002	0.021
Blow-Me-Down Brook (Stream B)	5/20/2008	792.0	20	9	1.9	<MRL 1	0.190	0.163	0.101	<MRL 0.005	

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A2. Laboratory nutrient chemistry data for SAGA (continued).

Site	Date	ANC (µeq/L)	Apparent Color (PCU)	TP (µg/L)	TDP (µg/L)	SRP (µg/L)	TN (mg/L)	TDN (mg/L)	NO ₂ +NO ₃ (mg/L)	NO ₂ (mg/L)	NH ₃ (mg/L)
Blow-Me-Down Brook (Stream B)	8/22/2008	1,000.0	37	27	3.1	<MRL 1	0.225	0.227	0.104	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	5/7/2009	834.0	35	14	4.1	<MRL 1	0.206	0.225	0.113	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	8/20/2009	1,170.0	48	16	5.2	1.3	0.303	0.273	0.114	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	5/25/2010	957.0	33	16	6.8	1.9	0.294	0.278	0.091	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	8/11/2010	1,350.0	86	43	5.2	<MRL 1	0.314	0.207	0.011	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	5/24/2011	672.0	31	14	4.5	1.3	0.268	0.238	0.113	<MRL 0.005	<MRL 0.08
Blow-Me-Down Brook (Stream B)	8/23/2011	820.0	73	41	9.4	2.6	0.556	0.388	0.096	<MRL 0.005	<MRL 0.08

Appendix A. Saint-Gaudens National Historic Site (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for SAGA. *Missing values indicate data are unavailable.*

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Blow-Me-Down Pond	5/16/2006	2.04			N/A
Blow-Me-Down Pond	6/13/2006				N/A
Blow-Me-Down Pond	7/20/2006	2.58			N/A
Blow-Me-Down Pond	8/17/2006	2.80			N/A
Blow-Me-Down Pond	9/14/2006	2.25			N/A
Blow-Me-Down Pond	10/11/2006	2.88			N/A
Blow-Me-Down Pond	4/4/2007	2.17			N/A
Blow-Me-Down Pond	5/8/2007	4.88	New tape down site, old one is gone		N/A
Blow-Me-Down Pond	6/7/2007	5.00			N/A
Blow-Me-Down Pond	7/2/2007	1.50	New tape down location		N/A
Blow-Me-Down Pond	8/14/2007				N/A
Blow-Me-Down Pond	9/11/2007	2.50			N/A
Blow-Me-Down Pond	10/12/2007	3.50			N/A
Blow-Me-Down Pond	5/19/2008	0.32			N/A
Blow-Me-Down Pond	6/16/2008	3.27			N/A
Blow-Me-Down Pond	7/21/2008	2.96			N/A
Blow-Me-Down Pond	8/22/2008				N/A
Blow-Me-Down Pond	9/23/2008				N/A
Blow-Me-Down Pond	10/13/2008	3.00			N/A
Blow-Me-Down Pond	5/7/2009				N/A
Blow-Me-Down Pond	6/18/2009	3.04			N/A
Blow-Me-Down Pond	7/21/2009	2.96			N/A
Blow-Me-Down Pond	8/20/2009	2.90			N/A
Blow-Me-Down Pond	9/30/2009	2.96			N/A
Blow-Me-Down Pond	10/22/2009	2.94			N/A
Blow-Me-Down Pond	5/25/2010	2.92			N/A
Blow-Me-Down Pond	6/15/2010	2.98			N/A
Blow-Me-Down Pond	7/8/2010	3.08			N/A
Blow-Me-Down Pond	8/11/2010	3.08			N/A
Blow-Me-Down Pond	9/8/2010	3.14			N/A
Blow-Me-Down Pond	10/4/2010	3.00			N/A
Blow-Me-Down Pond	5/23/2011	2.44			N/A
Blow-Me-Down Pond	6/21/2011	2.96			N/A
Blow-Me-Down Pond	7/19/2011				N/A
Blow-Me-Down Pond	8/23/2011	3.15			N/A
Blow-Me-Down Pond	9/21/2011	2.84			N/A
Blow-Me-Down Pond	10/12/2011	2.83			N/A
Blow-Me-Up Brook (Stream A)	5/16/2006		6.30	1.93	12.33
Blow-Me-Up Brook (Stream A)	6/13/2006		4.63	1.34	6.75

Appendix A. Saint-Gaudens National Historical Park (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for SAGA (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Blow-Me-Up Brook (Stream A)	7/20/2006	0.89	2.23	0.88	1.80
Blow-Me-Up Brook (Stream A)	8/17/2006	1.05	1.04	0.35	0.35
Blow-Me-Up Brook (Stream A)	9/14/2006	1.13	0.93	0.31	0.29
Blow-Me-Up Brook (Stream A)	10/11/2006	1.10	1.14	0.41	0.37
Blow-Me-Up Brook (Stream A)	4/4/2007	0.71	3.33	1.81	6.14
Blow-Me-Up Brook (Stream A)	5/8/2007	0.88	2.26	1.00	2.12
Blow-Me-Up Brook (Stream A)	6/7/2007	0.91	1.24	1.04	1.31
Blow-Me-Up Brook (Stream A)	7/2/2007	1.13	0.21	0.48	0.09
Blow-Me-Up Brook (Stream A)	8/14/2007	1.21	0.18	0.20	0.04
Blow-Me-Up Brook (Stream A)	9/11/2007	1.15	0.45	0.33	0.15
Blow-Me-Up Brook (Stream A)	10/12/2007	1.02	2.56	0.54	1.86
Blow-Me-Up Brook (Stream A)	5/20/2008	0.90	2.18	0.45	1.01
Blow-Me-Up Brook (Stream A)	6/16/2008	1.04	0.94	0.27	0.22
Blow-Me-Up Brook (Stream A)	7/22/2008	1.00	1.43	0.32	0.46
Blow-Me-Up Brook (Stream A)	8/22/2008	0.92			
Blow-Me-Up Brook (Stream A)	9/24/2008	1.00		0.29	
Blow-Me-Up Brook (Stream A)	10/13/2008	0.96	1.97	0.25	0.46
Blow-Me-Up Brook (Stream A)	5/7/2009	0.77	3.94	0.51	2.00
Blow-Me-Up Brook (Stream A)	6/18/2009	0.96	2.33	0.20	0.46
Blow-Me-Up Brook (Stream A)	7/21/2009	0.90	2.71	0.31	0.83
Blow-Me-Up Brook (Stream A)	8/20/2009	0.88	2.26	0.37	0.83
Blow-Me-Up Brook (Stream A)	10/1/2009		1.44	0.48	0.69
Blow-Me-Up Brook (Stream A)	10/22/2009	0.88	3.75	0.21	0.77
Blow-Me-Up Brook (Stream A)	5/25/2010	0.83	1.82	0.65	1.18
Blow-Me-Up Brook (Stream A)	6/14/2010		1.26	0.51	0.65
Blow-Me-Up Brook (Stream A)	7/8/2010	1.08	0.05	0.14	0.08
Blow-Me-Up Brook (Stream A)	8/11/2010	1.15	0.76	0.05	0.04
Blow-Me-Up Brook (Stream A)	9/8/2010		0.27	0.03	0.01
Blow-Me-Up Brook (Stream A)	10/5/2010	0.98	1.23	0.13	0.16
Blow-Me-Up Brook (Stream A)	5/24/2011	0.68	2.58	1.58	4.07
Blow-Me-Up Brook (Stream A)	6/20/2011	0.83	1.20	0.67	0.80
Blow-Me-Up Brook (Stream A)	7/19/2011	0.91	0.67	0.26	0.17
Blow-Me-Up Brook (Stream A)	8/23/2011	0.86	1.23	0.43	0.53
Blow-Me-Up Brook (Stream A)	9/21/2011	0.82	2.04	0.59	1.20
Blow-Me-Up Brook (Stream A)	10/13/2011		15.43	1.99	30.62
Blow-Me-Down Brook (Stream B)	6/13/2006		50.49	2.09	112.58
Blow-Me-Down Brook (Stream B)	7/20/2006		20.95	1.43	30.30
Blow-Me-Down Brook (Stream B)	8/17/2006	1.91	12.06	0.88	10.89
Blow-Me-Down Brook (Stream B)	9/14/2006	2.09	6.66	0.71	5.64
Blow-Me-Down Brook (Stream B)	10/11/2006	1.94	7.54	1.01	8.12
Blow-Me-Down Brook (Stream B)	4/4/2007	0.75	39.53	2.32	90.55

Appendix A. Saint-Gaudens National Historical Park (SAGA) Water Monitoring Data, 2006-2011 (continued).

Table A3. Stream stage and discharge data for SAGA (continued).

Site	Date	Tapedown from datum (ft)	Total cross section area (sqft)	Average velocity (f/s)	Discharge (cfs)
Blow-Me-Down Brook (Stream B)	5/8/2007	1.40	21.71	1.39	30.51
Blow-Me-Down Brook (Stream B)	6/7/2007	1.32	23.71	1.48	35.88
Blow-Me-Down Brook (Stream B)	7/2/2007	2.01	4.24	0.70	3.18
Blow-Me-Down Brook (Stream B)	8/14/2007	2.02	4.49	0.62	2.94
Blow-Me-Down Brook (Stream B)	9/11/2007		4.98	1.31	6.27
Blow-Me-Down Brook (Stream B)	10/12/2007	1.52	21.80	0.91	20.38
Blow-Me-Down Brook (Stream B)	5/20/2008	1.54	12.21	1.33	17.30
Blow-Me-Down Brook (Stream B)	6/16/2008	1.82	8.90	0.63	6.35
Blow-Me-Down Brook (Stream B)	7/21/2008	1.54	13.25	1.21	17.93
Blow-Me-Down Brook (Stream B)	8/22/2008	1.58			
Blow-Me-Down Brook (Stream B)	9/24/2008	1.79		0.69	
Blow-Me-Down Brook (Stream B)	10/13/2008	1.73	9.91	0.86	9.35
Blow-Me-Down Brook (Stream B)	5/7/2009	1.10	23.42	1.68	39.30
Blow-Me-Down Brook (Stream B)	6/18/2009	1.65	9.44	1.12	10.56
Blow-Me-Down Brook (Stream B)	7/21/2009	1.58	11.94	1.23	14.69
Blow-Me-Down Brook (Stream B)	8/20/2009	1.53	11.79	1.16	13.62
Blow-Me-Down Brook (Stream B)	10/1/2009	1.66	11.06	1.06	11.76
Blow-Me-Down Brook (Stream B)	10/22/2009	1.58	19.86	0.61	12.78
Blow-Me-Down Brook (Stream B)	5/25/2010	1.54	11.39	1.41	16.09
Blow-Me-Down Brook (Stream B)	6/14/2010	1.58	10.27	1.05	11.05
Blow-Me-Down Brook (Stream B)	7/8/2010		5.55	0.39	2.18
Blow-Me-Down Brook (Stream B)	8/11/2010	1.40	14.66	0.17	2.54
Blow-Me-Down Brook (Stream B)	9/8/2010	2.17	3.87	0.06	0.23
Blow-Me-Down Brook (Stream B)	10/4/2010	1.20	19.01	0.61	11.52
Blow-Me-Down Brook (Stream B)	5/24/2011	0.79	26.99	2.63	71.07
Blow-Me-Down Brook (Stream B)	6/20/2011	1.56	10.93	1.00	10.94
Blow-Me-Down Brook (Stream B)	7/18/2011	1.78	7.33	0.67	4.88
Blow-Me-Down Brook (Stream B)	8/23/2011	1.26	16.43	9.50	24.57
Blow-Me-Down Brook (Stream B)	9/21/2011	1.30	15.16	1.60	24.22
Blow-Me-Down Brook (Stream B)	10/12/2011	0.76	2.23	0.74	1.65

Table A4. Pond water transparency data for SAGA. “B” after transparency value indicates disk pattern still visible at pond bottom or through fully filled turbidity tube.

Site	Date	Secchi Depth (m)	Turbidity Tube (cm)
Blow-Me-Down Pond	5/16/2006	0.73	
Blow-Me-Down Pond	7/20/2006	1.65 B	
Blow-Me-Down Pond	8/17/2006	1.60 B	
Blow-Me-Down Pond	6/16/2008		120.0 B
Blow-Me-Down Pond	7/21/2008		120.0 B
Blow-Me-Down Pond	8/22/2008		120.0 B
Blow-Me-Down Pond	10/13/2008		120.0 B
Blow-Me-Down Pond	5/7/2009		120.0 B
Blow-Me-Down Pond	6/18/2009		85.0 B
Blow-Me-Down Pond	7/21/2009		120.0 B
Blow-Me-Down Pond	8/20/2009		120.0 B
Blow-Me-Down Pond	9/30/2009		120.0 B
Blow-Me-Down Pond	5/25/2010		115.0
Blow-Me-Down Pond	6/15/2010		60.0
Blow-Me-Down Pond	7/8/2010		68.0
Blow-Me-Down Pond	8/11/2010		38.8
Blow-Me-Down Pond	9/8/2010	0.74	
Blow-Me-Down Pond	10/4/2010		120.0 B
Blow-Me-Down Pond	5/23/2011	1.03	
Blow-Me-Down Pond	6/21/2011		120.0 B
Blow-Me-Down Pond	7/19/2011		120.0 B
Blow-Me-Down Pond	8/23/2011		61.1

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 428/115333, June 2012

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

EXPERIENCE YOUR AMERICA™