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Lake Site Assessments: US EPA TIME-New England Lakes

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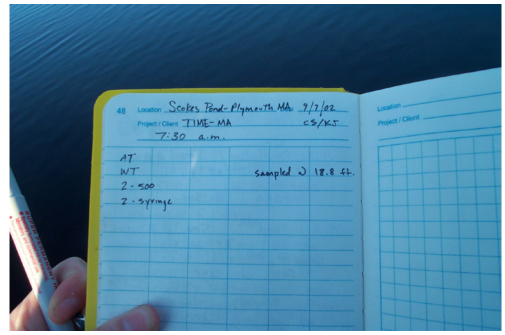
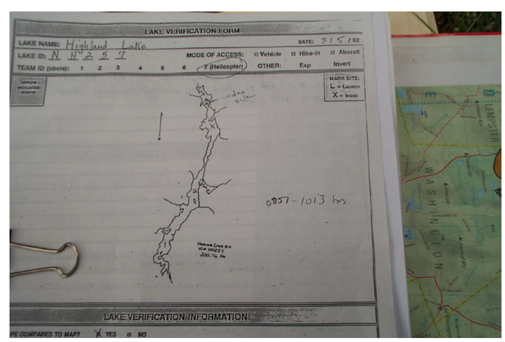
Acknowledgements

This report is dedicated to all of the field staff, past and present, who make this research possible. Long hikes with outdated directions and no GPS reception; trails not maintained in decades, ankle-busters, no trespassing signs, poison ivy, and angry locals; hot weather, thunderstorms, rainstorms; popped boats, forgotten paddles, dropped sample containers; mosquitos, deerflies, mayflies, bears, and leeches; floating bogs, stranded vehicles, bloody injuries, and mud pits - and yet every field day is a good day at work, a badge of honor. Not only do the field crews endure tough working conditions, they do it with a positive attitude and volunteer to go again next year to these now-familiar places. Some of the places are among the most beautiful, remote spots in the region; others are busy meccas for folks not lucky enough to get paid to hike, sneaking out to a busy lake for a couple of weekend hours to catch a quick paddle or fishing trip. This project brings all of these places together, and provides the field crew the opportunity to share first-hand knowledge and professional judgement about which places are good sentinels for change in our region. This document consulted not only peer-reviewed and gray literature, but gave equal weight to field notes - written since the first EMAP sampling at each lake - carefully recorded by decades of field crews on waterproof paper sometimes stained with mud, blood, and mosquito parts. First-hand observation from those who know the sites, eat their lunch by the beaver dam, and lose their shoes in the floating bog is an irreplaceable part of the data record, and we thank all the field crews - including report contributors - who have worked hard to find and know these lakes.

It seems most fitting to list the field crews by their initials, written across many, many pages of field books:

AB, CS, EG, KJ, SJN, JM, MD, CR, ES, HG, EJ, DK, JSK, JM, TH, JC, RD, SS, CM, BL, JP, AR, AG, SM, JM, KEW, and of course, the original EPA EMAP teams, identified only by team numbers 1-7 in the database.





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Foreword

Tracking Acid Rain Across New England
by Catherine Schmitt

Russell Pond, New Hampshire
August 27, 2003, 5:15 am:
It is just before sunrise in the White Mountains, and the blank spot where the man in the mountain used to be is nothing more than a shadow of gray on gray. Ken and I turn off the Tripoli Road into Russell Pond campground. We untie the kayak from the roof of the car and grab sample bottles from a cooler in the back. I climb into the kayak and Ken gives me a push toward the middle of the quiet pond. Mars is a pinprick of light in the lavender sky above me as I reach into the water, rinsing and filling the plastic bottles. I paddle back to shore, we strap the boat back to the roof and put the bottles in the cooler. We leave Russell pond before the nearby campers begin to stir from their tents.

This is the first of fourteen lakes we will sample today in New Hampshire; last week there were twelve in Massachusetts, Rhode Island, and Vermont. Next week I will visit two lakes in New York. We are taking water samples for a research project funded by the EPA to evaluate the effectiveness of the Clean Air Act Amendments of 1990. These lakes are a subset of more than 300 lakes in New England. The lake water chemistry is compared to other lakes in the Adirondacks, Appalachians, and Blue Ridge mountains, all areas sensitive to acid rain. The Northeast is vulnerable to acid rain because weather patterns carrying pollution from the Midwestern U.S. and Canada converge over northern New England before heading out over the North Atlantic.

So here we are criss-crossing New England, from one lake to the next. From Skokes Pond, an unexpected hole punched in the coast of Massachusetts, surrounded by a twisted maze of private sandy drives, towering mansions, and salt-worn cottages, to Copicut Reservoir, reached by a road no smoother than a dry riverbed. At Copicut we note that the water levels are higher than last year, the drought is over and what were exposed shorelines are now wetlands soaked to the brim.

Touring the New England landscape, we see that sprawl is everywhere. It's in Plymouth, in Belchertown, in Kingston, and Keene; each year there is a little less green and a few more No Trespassing signs. I remembered Muddy Pond as a tranquil beaver-dammed lake

on conservation land, but this year the woods have been razed and a road is being built. A lone backhoe pushes the fresh soil around, and pauses so that we can hike by. On Route 100 in Vermont they are erasing a mountain and moving a river so that the road can be straighter so that tractor-trailers can go faster around the turns. We wait in line, crawling at five miles an hour between orange cones over the blasted road. We roll the windows up because of the dust. It's hot and we are sweaty and tired.

As I paddle back to shore at a crowded pond in New Hampshire, a man comes out of his house and walks to the end of his dock and yells at me, "This is a private pond!" I explain to him that we are doing sampling for the Mitchell Center for the EPA and we come every year. "No you don't," he says. He says people have come before and taken water samples from his pond and then tried to tell him what to do with his land. We explain that we are sampling for acid rain, and not algae, and we are not there to tell him what to do with his Technicolor green lawn. Later at Hodge Pond I decide I'd rather drag the boat through the cold stagnant water of the bog than hike through the mosquito-hung woods and my legs are scraped and scratched by leatherleaf twigs. Ken and I swear at the thirsty bugs and the thick woods and the heavy boat.

It may seem strange to sample water as a measure of clean air. Lakes are a mirror, not just of the sky on a quiet morning, but of the pollution falling from the sky. Fossil fuels are burned, smoke loaded with sulfur and nitrogen rises to the sky. The chemicals stick to dust that settles back to earth, mix with rain and snow, turning water to a weak solution of acid. So anything that affects one aspect of the environment eventually reaches all the others; so smokestack exhaust becomes acidic rains; air pollution becomes water pollution.

Some of these lakes that we are visiting have been sampled for decades in an effort to track improvements in water quality as air pollution declined due to the Clean Air Act. The 1990 Clean Air Act Amendments have been successful in reducing the amount of sulfuric acid in rain, but lakes in New England have not recovered as well as lakes in other areas such as the Adirondacks and Appalachians. Though scientists are not sure why, somehow the years of acid rain have reduced the lakes' ability to bounce back. It will take longer records to understand trends in ecological responses; we continue to monitor the lakes, year after year after year, tracking progress. Trying to understand where we are going by knowing where we've been.

Ivanhoe Pond, NH, 8:00 pm. Mars is bright, as it was this morning. The only sounds are distant roads, the day's last chorus of cicadas, and the splash of my paddle hitting the ink-black water ironed flat by the weight of the day. Bats cartwheel and dive at the surface of the lake around me. When I turn around to paddle back to shore it has gotten so dark that I can barely see the landing from where I came. I call out for Ken but he is busy at the car, and I slowly make my way along the shore, looking for him. As I drift by houses with rooms lit golden by lamps, I see people inside, making dinner, watching TV, unaware of my presence. I find Ken at the launch and we drag the boat out of the water one last time, and begin the long dark drive back to Maine.

At the time of this writing, Catherine Schmitt and Ken Johnson were research assistants at the Senator George J. Mitchell Center for Environmental & Watershed Research at the University of Maine.

From "Tracking Acid Rain across New England," Northern Sky News, November 2003.

Catherine in North Pond, 2003

TIME New England lakes and TIME Adirondack lakes

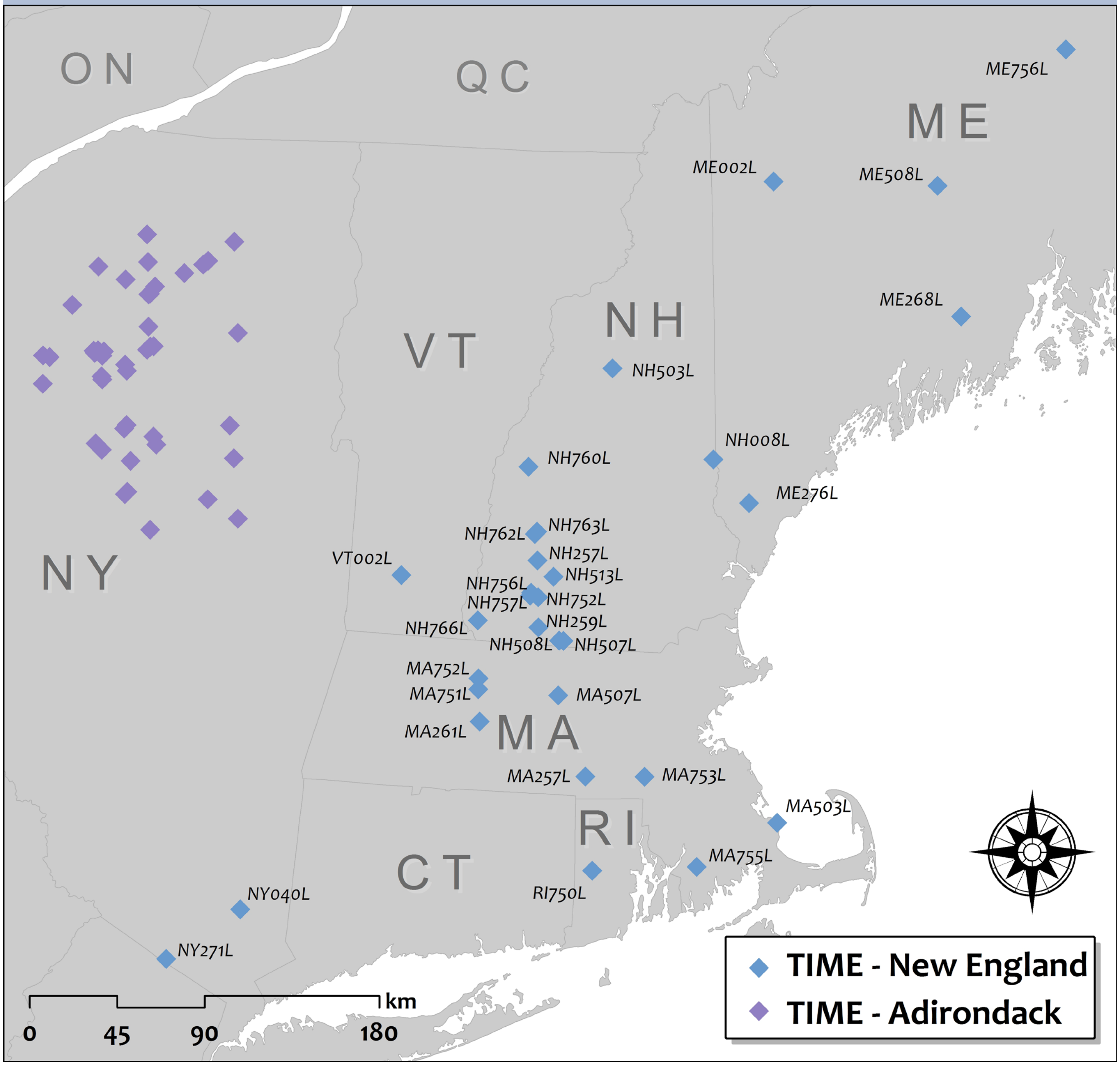


Figure 1. The 31 TIME New England lakes - which also include two lakes in the lower Hudson River Valley of New York state - are the subjects of this report. The 43 TIME Adirondack lakes are part of the same long-term monitoring program, and are summarized in a compendium of lakes spanning multiple research proejcts in the Adirondack region. For details on the Adirondack sites, see: http://www.adirondacklakessurvey.org.

Map data courtesy of the Maine Office of GIS and the University of Maine Senator George J. Mitchell Center for Environmental and Watershed Research. Maps in this report were developed by S. Nelson.

Please note: this document does not grant permission to trespass on private property. Every effort should be made to contact landowners or appropriate state/local contacts prior to sampling.

Introduction

TIME (Temporally Integrated Monitoring of Ecosystems) is a statistically selected population of lakes in New England and the Hudson Valley (31 lakes) and the Adirondacks (43 lakes) that were selected from the original 1991 EMAP-SW (Environmental Monitoring and Assessment Program–Surface Waters) population with acid neutralizing capacity less than 100 μeq/L (Young & Stoddard 1996). Samples are taken annually, during a summer base-flow 'index period'. This sampling strategy is used to reduce hydrologic impact on water chemistry and hence provide an assessment of trends in chemistry with the least number of samples (e.g., Stoddard *et al.* 2003).

The EMAP program sampled these lakes and many others one or more times between 1991-1994. As part of EMAP, the lakes were characterized with respect to landscape features, hydrology, geology, and chemistry as well as biological studies (fish, breeding birds, zooplankton) and a paleo-limnological coring study to reconstruct pH and other variables. The program was discontinued, but some sampling of the lakes continued through other funding sources during the hiatus. In 1999, the TIME project officially began, with a goal of assessing the effectiveness of the Clean Air Act Amendments of 1990 at reducing acidification of surface waters (Stoddard *et al.* 2003, Kahl *et al.* 2004). As of this writing, the lakes have records spanning two decades or more.

These lakes are sensitive to acidic deposition, and they span a broad range of landscape settings and disturbance histories. As lakefront property has become more thickly-settled by seasonal and year-round homes, and urban areas have grown more congested, some lakes have also become sentinels of human stressors across the region. Other lakes have become less human-affected: forests in New England's more rural areas are now more continuous than during the 19th Century. Climate change exerts additional pressure across the region, and with their long-term data record, these lakes may serve as a template for predicting the effects of these changes on freshwaters in the region. An evolving program, TIME now characterizes surface waters across the region in response to landscape and temporal change, with current research projects leveraging the base monitoring program to evaluate climate change effects on surface waters, and mercury in northeastern ecosystems.

This document includes details about each lake to address several goals.

First, many of the landscape characteristics regarding each lake (e.g., landcover statistics) had not been recalculated since the original EMAP study. The New England landscape has changed dramatically since the early 1990s, and this work updates these important characteristics.

Second, the chemistry of some of the lakes suggests significant road salt contamination or other factors that may compromise their utility as long-term sentinels. This report lists considerations about each lake and its watershed.

Third, program managers had not yet determined what other information might exist for each lake. Wickett Pond in Massachusetts, for example, was the subject of a detailed paleolimnological study that provided background information about two centuries of land-use change in the watershed. Copicut Reservoir, very recently (1970s) inundated, is actually a former quarry. And Bog Pond in Maine was once a prospective commercial peat harvesting site; details about peat depth and spatial arrangement provide insight about potential patterns and sources of dissolved organic carbon in the pond.

Fourth, long-term mean chemistry data for each lake were not easily accessed. This document includes a summary table of the key chemical parameters measured in the program, as well as graphics displaying changes in pH and sulfate throughout the program. Supplemental graphics showing each pond's zooplankton, fish, and breeding bird species richness and mercury in fish measured during EMAP are also included when data were available.

Fifth and finally, updates to directions to find many of the ponds were scribbled in fieldbooks and since the project pre-dated common use of GPS units, characteristics such as coordinates of parking areas are now as valuable as trail descriptions. This document provides updated directions to each lake, with photos and descriptions of key features.

Taken together, the TIME lakes provide a picture of response to acidic deposition across the Northeast. They also illustrate the wide variability in lakes across the region: from tiny remote ponds to large, crowded lakes with beaches and speedboats. With more than 20 years of data collected under the guidance of EPA, the lakes represent a long-term record sampled at a regional scale. Although some features of a lake or watershed may limit interpretation of patterns in their geochemistry or response to a specific stressor, those lakes provide information about other concurrent stressors. The table below summarizes the major considerations regarding each lake and its watershed, based on information in each lake's more detailed description (Table 1).

Table 1. Summary assessment table. Based on data in this assessment, the table below summarizes major considerations regarding the utility of each lake or pond as a sentinel for long-term change. Blank cells denote "no data". Data regarding trophic status and lake stratification (not shown - only a few reported data) are largely missing.

TIME ID	Lake Name	Landscape setting	Conserved watershed	Road salt	Flow alteration	Trophic status	Acid-base considerations
MA257L	Reservoir Number Six	Rural	Focal area		Dam		Possibly naturally acidic (EMAP core)
MA261L	Knights Pond	Rural	Focal area	Probable	Dam		
MA503L	Scokes Pond	Urban	Focal area	Coastal		Eutrophic (1970s)	
MA507L	Bickford Pond	Rural	Focal area	Probable	Dam	Oligotrophic (1980s)	
MA751L	Lake Wyola	Developed	Focal area	Probable	Dam		
MA752L	Wickett Pond	Remote	State Forest, Focal area	Probable	Dam	Oligotrophic (1994)	
MA753L	Kingsbury Pond	Urban		Probable	Dam		
MA755L	Copicut Reservoir	Rural	State Park, State Forest, Focal area	Coastal	Dam		
ME002L	Mountain Pond	Remote					
ME268L	Muddy Pond	Rural		Coastal		Mesotrophic	
ME276L	Round Pond	Rural	Focal area	Coastal		Oligotrophic	Naturally acidic due to bog
ME508L	Bog Pond	Rural					Naturally acidic due to bog
ME756L	East Branch Lake	Remote	Penobscot Nation				
NY040L	Clear Lake	Rural	Focal area				
NY271L	Little Cedar Pond	Remote	State Park, Focal area				Possibly naturally acidic due to bog
RI750L	Quidnick Reservoir	Rural		Coastal	Dam	Oligotrophic	
VT002L	Somerset Reservoir	Remote			Dam	Mesotrophic	

Table 1, continued. Summary assessment table.

TIME ID	Lake Name	Landscape setting	Conserved watershed	Road salt	Flow alteration	Trophic status	Acid-base considerations
NH008L	Lake Ivanhoe	Developed		Probable	Filled outlet?	Oligotrophic	Historically lower alkalinity (EMAP core)
NH257L	Highland Lake	Developed	Focal area		Dam	Mesotrophic	
NH259L	Hodge Pond	Remote	Focal area				
NH503L	Russell Pond	Remote	State Park			Oligotrophic	
NH507L	Pratt Pond	Developed			Dam	Mesotrophic	Historically lower alkalinity (EMAP core)
NH508L	Island Pond	Rural			Dam		
NH513L	Gregg Lake	Developed	Focal area		Dam	Oligotrophic	
NH752L	Skatutakee Lake	Developed	Focal area	Probable	Dam	Mesotrophic	
NH756L	Seaver Reservoir	Rural	Focal area	Probable	Dam	Mesotrophic	
NH757L	Childs Bog	Rural	Focal area	Probable	Dam	Oligotrophic	n/a (human-made)
NH760L	Miller Pond	Rural	Focal area		Dam		
NH762L	North Pond	Remote	State Park			Eutrrophic	
NH763L	May Pond	Remote	State Park			Mesotrophic	Possible spring episodic acidification (DOC) (NH DES 2009)
NH766L	Pisgah Reservoir	Remote	State Park, Focal area		Dam	Mesotrophic	Probably naturally acidic (EMAP core)

Somerset Reservoir Dam and outflow pipe in 2002.

Photos: K. Johnson

Each lake's descriptive assessment includes tables with mean and standard deviation for each chemical parameter measured as part of the TIME project, as well as landscape characteristics regarding each lake. Details regarding these data and methodology used in analyses follow (Table 2).

Table 2. Variable names, detection limits, and laboratory methods for samples taken as part of the TIME project, 1999-present. Consult EMAP documentation (Baker *et al.* 1997; Chaloud & Peck 1994) for further details on methodology during 1991-1994.

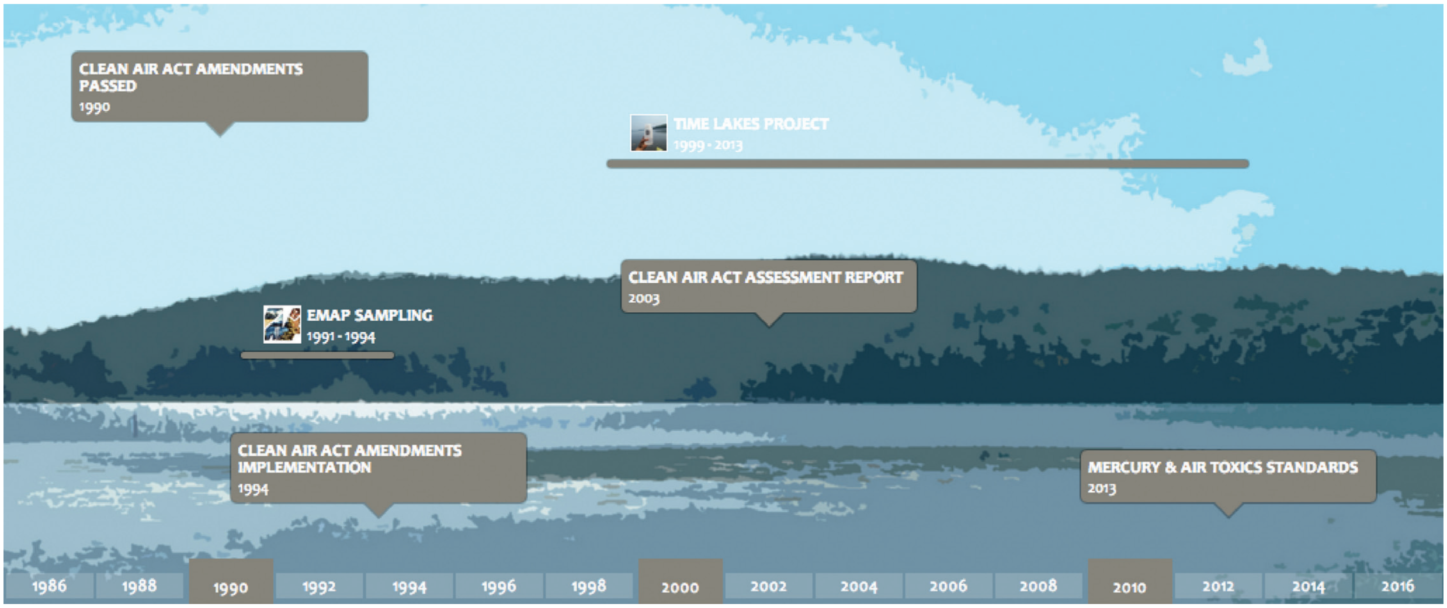
Variable	Units	Detection limit	Method
EqpH	pH units	n/a	Air-equilibrated pH, determined by electrode
ClpH	pH units	n/a	Closed-cell pH, determined by electrode
ANC	µeq • L^{-1}	n/a	Acid-neutralizing capacity, determined by Gran titration
DOC	mg • L^{-1}	0.1	Dissolved organic carbon, determined by infrared carbon analyzer, persulfate oxidation
Cond	µS • cm^{-1}	n/a	Measured Conductivity, determined with a Wheatstone bridge
Color - true	Pt-Co units	n/a	Filtered sample, determined by 475.5 nm spectrophotometer
Color - apparent	Pt-Co units	n/a	Unfiltered sample, determined by 475.5 nm spectrophotometer until 2002 and by color wheel 2003-2004.
Ca^{2+}	µeq • L^{-1}	0.5	• Determined by Atomic Absorption Spectrophotometry (AAS) with N_2O-acetylene flame (1998 and prior) • Inductively Coupled Atomic Emission Spectroscopy (ICP) from 1999-2003 • Ion Chromatography (2004 forward)
Mg^{2+}	µeq • L^{-1}	0.8	
K^+	µeq • L^{-1}	0.3	
Na^+	µeq • L^{-1}	0.4	
Al (Total)	µg • L^{-1}	1	• Determined by Inductively Coupled Atomic Emission Spectroscopy (ICP) (data from 1998 or before) • Determined by atomic absorption spectroscopy with graphite furnace (2004 forward)
SO_4^{2-}	µeq • L^{-1}	0.5	Ion Chromatography
NO_3^-	µeq • L^{-1}	0.1	Ion Chromatography
Cl^-	µeq • L^{-1}	0.5	Ion Chromatography
SiO_2	mg • L^{-1}	0.1	Silica (as SiO_2), determined by autoanalyzer; 2006 and later.
Total P	µg • L^{-1}	0.5	Total phosphorus, determined by manual colorimetry
Total N	µg • L^{-1}	25	Total nitrogen, determined by automated colorimetry

Table 3. Data sources and processing methods for watershed and lake characteristics. Published sources are given in the individual lake tables for values derived from the literature or other databases. Landcover for each lake was calculated based on the total watershed, including the target lake itself. Wetlands estimates do not include the target lake itself. Because wetlands sources vary, total landcover sums in each watershed might not equal 100%.

Topographic maps were created using DeLorme Topo USA® 7.0 software, or from NH Fish & Game (http://www.wildlife.state.nh.us/Fishing/bathy_maps.htm), which included lake depth maps. Maine depth maps were from ME Inland Fisheries & Wildlife, (http://www.maine.gov/ifw/fishing/lakesurvey_maps). Other bathymetric map sources varied, and are cited in the text.

Variable	Data source(s)	Processing methods
Lake area	NHDPlus (Horizon Systems, 2006)	Calculate areas in ArcGIS 10.3
Watershed area	Provided by US EPA	Cross-checked (NHDPlus, NED) & hand-digitized
Mean and maximum depth	Bathymetric maps, ME, NH state data sources, literature sources referenced in assessments, US EPA EMAP database	Evaluation of existing data
Lake drainage class	EPA ELS-I classification scheme (Linthurst et al., 1986): • Seepage: no inlets, no outlet • Drainage: outlet • Closed: inlets, no outlet • Reservoir: outlet control structure present	Topographic maps, field notes, dam databases referenced in assessments
Number of inlets and outlets	Field observation, topographic maps	Direct observation, map interpretation, dam databases referenced in assessments
Flow alteration	National listing of dams, town and state dam records, field observation	Evaluation of existing data
Minimum & maximum elevation in watershed	National Elevation Dataset (NED; USGS, 2013a)	Determined using 30 x 30 m mosaicked DEMs for the region
Slope (degrees)	National Elevation Dataset (NED; USGS, 2013a)	Determined using 30 x 30 m mosaicked DEMs for the region
Landcover	NLCD 2006 (Fry *et al.*, 2011)	Zonal statistics in ArcGIS 10.3 spatial analyst. Classes were combined as follows: • *Developed, open space and low-intensity (<50% impervious)* = Developed, Open Space + Developed, Low Intensity • *Developed, medium to high density (≥50% impervious)* = Developed, Medium Intensity + Developed High Intensity • *Shrub & Herbaceous* = Shrub/Scrub + Grassland/Herbaceous • *Agriculture (hay, cultivated)* = Pasture/Hay + Cultivated Crops
Wetland cover in watershed (%)	MA: National Wetlands Inventory (NWI) for MA257L, MA261L, MA503L, MA752L; NLCD for remaining 4 lakes ME: Maine Office of GIS (Lg_wets.shp) NH, VT: NWI except NH503L (NLCD) NY: NLCD RI: RIGIS (wetlands93.shp)	Zonal statistics in ArcGIS 10.3 spatial analyst. When NWI coverage was incomplete or appeared erroneous (negative values when lake areas was substracted), NLCD data (woody wetlands + emergent herbaceous wetlands) were used. When state coverage was more detailed, state coverages were used.
Impervious surface (%)	NLCD 2006 (Fry *et al.*, 2011)	Zonal statistics (mean), ArcGIS 10.3 spatial analyst
Bedrock type (%)	USGS, 2013b	Zonal statistics in ArcGIS 10.3 spatial analyst

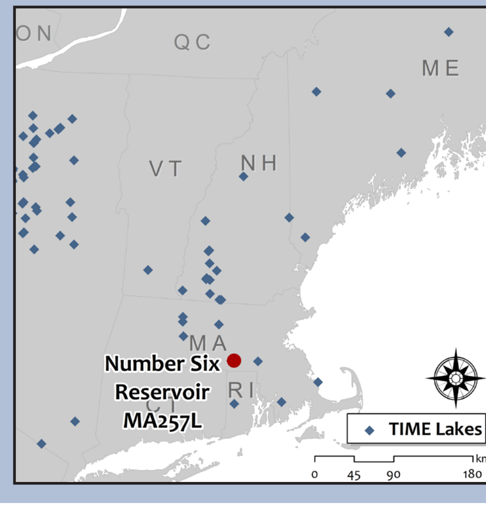
Timeline: Sampling, legislative, and assessment events related to EPA-TIME lakes.



Timeline created using Tiki-Toki, web-based software for creating timelines. http://www.tiki-toki.com/

University of Maine sampling in 2003.

Photo: C. Rosfjord.



Reservoir Number Six

Lake ID: MA257L
Other IDs: GNIS ID: 611041; PALSITE: 51130.0001

Lake description

One of the many reservoirs in Sutton, Reservoir Number Six is in a relatively secluded area without any homes in close proximity. There are several larger tracts of protected, public access lands (state parks, state forests) surrounding the pond and several potential vernal pools in the watershed.[1]

Reservoir Number Six (and surrounding area) is identified within both BioMap2 Core Habitat ("key areas that are critical for the long-term persistence of rare species and other Species of Conservation Concern, as well as a wide diversity of natural communities and intact ecosystems across the Commonweath" and Critical Natural Habitat ("large natural landscape blocks that are minimally impacted by development").[2] Core Habitat block 1176 in Sutton is the fifth largest in the ecoregion and features forest, wetland, and vernal pool cores. Around the lake, the forest is primarily hardwood and has a relatively open character.

In past summers, including 2010, there was not enough water in the reservoir to take a sample and there was a high abundance of algae throughout the reservoir. Depth at the sampling site has been <2 meters.

There is a private dam (NATID: MA00899) owned by the Whitinsville Water company; it is listed as a low hazard dam on a Tributary of Mumford River.[3]

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992 and1994. Zooplankton species richness in Reservoir Number Six was near the 25th percentile across all EMAP lakes.[4]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Corduliidae* and *Libellulidae* were collected.
Fisheries: There are no known survey data on presence or extirpation. No fish data were listed in EMAP data tables.[4]
Birds: Breeding birds were not listed in EMAP data tables.[4]

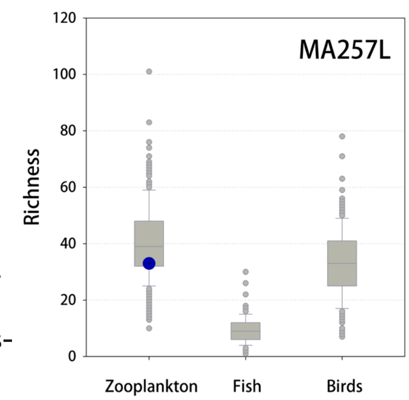


Figure MA257L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake, Reservoir No. Six (blue dot).

Bathymetry

No bathymetric map is available for Reservoir Number Six. However, the field sketch made by US EPA in late summer 1994, during low water conditions, indicates a depth at the sampling location of 4.8 m.

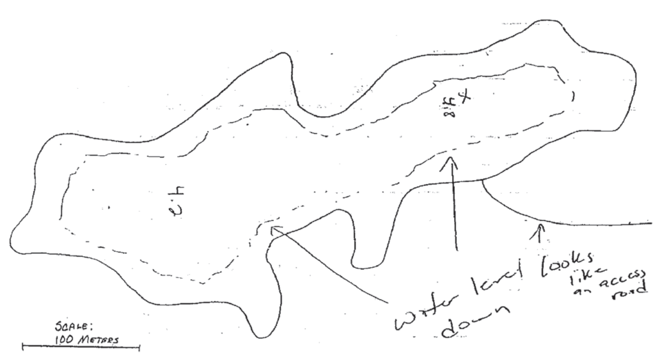


Table MA257L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	5.9
Watershed area (ha)	52.9
Mean depth (m)	0.84[4]
Max depth (m)	no data
Drainage class	reservoir
Number of inlets	0
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	175
Maximum watershed elevation (m)	225
Mean watershed slope (degrees)	3.1
Landcover (% of total watershed)	
Open water	10.7
Deciduous forest	**87.2**
Evergreen forest	1.2
Wetlands	3.1
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Granitic rocks	

Table MA257L.2. Long-term chemistry for Reservoir No. Six, 1992-2009. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.72	0.31	11
ClpH	pH units	5.49	0.16	11
ANC	$\mu eq \cdot L^{-1}$	5.15	6.73	11
DOC	$mg \cdot L^{-1}$	2.57	0.61	11
Cond	$\mu S \cdot cm^{-1}$	21.3	2.3	11
Color*	Pt-Co units	8|12	6|4	7|4
Ca^{2+}	$\mu eq \cdot L^{-1}$	54.3	6.9	11
Mg^{2+}	$\mu eq \cdot L^{-1}$	22.1	3.0	11
K^+	$\mu eq \cdot L^{-1}$	6.1	2.7	11
Na^+	$\mu eq \cdot L^{-1}$	74.1	8.8	11
Al (Total)	$\mu g \cdot L^{-1}$	71.6	30.0	11
SO_4^{2-}	$\mu eq \cdot L^{-1}$	95.1	16.8	11
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	11
Cl^-	$\mu eq \cdot L^{-1}$	46.1	7.1	11
SiO_2	$mg \cdot L^{-1}$	0.64	0.68	9
Total P	$\mu g \cdot L^{-1}$	7.9	3.2	5
Total N	$\mu g \cdot L^{-1}$	211	92	8

* Color is displayed as True|Apparent

Site disturbance & considerations

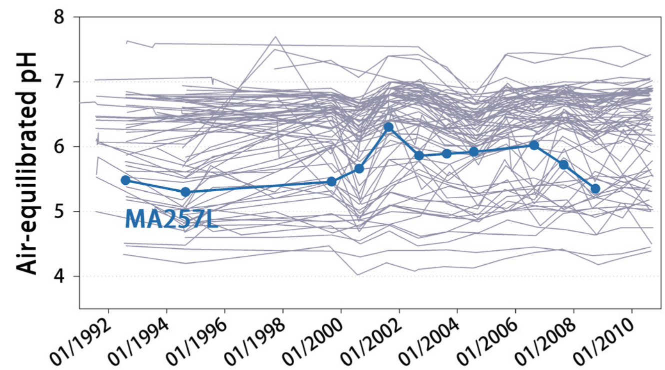
- Before sampling, contact the Massachusetts Environmental Police to check on the water level in the reservoir and ask permission to sample if the water level is sufficient.
- Water levels have been too low to sample in recent years. This lake's record is therefore sporadic and extreme values in past years should be used cautiously; water levels should be checked before using data.

Sampling history and other studies at this lake

Reservoir Number Six was cored in 1992 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[4] Based on the EMAP core at Reservoir Number Six, diatom-inferred pH was 5.56 in the bottom section (post-1850), and 5.81 in the top (recent) section.[4]

Reservoir Number Six was sampled for major ion chemistry and acid-base status in October 1984 and April 1985 as part of Massachusetts' Acid Rain Monitoring (ARM) program, which is led by the Water Resources Research Center at the University of Massachusetts Amherst.[6] Samples are collected by citizen volunteers. In those samples, pH was 5.3–5.4, similar to that reported by EMAP in the early 1990s (Figure MA257L.2). Sulfate in the two samples was 113 μeq/L (fall 1984) and 132 μeq/L (spring 1985), again consistent with early EMAP sampling of this lake (Figure MA257L.2).

The eastern shores of Reservoir Number Six. Photo: A. Baumann, 2009.



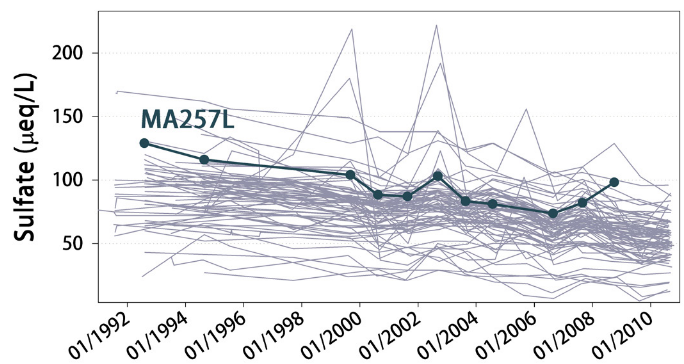


Figure MA257L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Reservoir Number Six, MA257L (thick blue line) has moderately low pH and moderately high sulfate measurements as compared to the TIME dataset. Water levels were too low to sample in recent years.

References

[1] MassDEP, 2013.

[2] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.

[3] MA DCR, 2012.

[4] US EPA, 2012.

[5] Nelson et al, 2011.

[6] Massachusetts Acid Rain Monitoring (ARM) Program, 2013.

Site access

From I-495 — 38 min, 19.9 mi

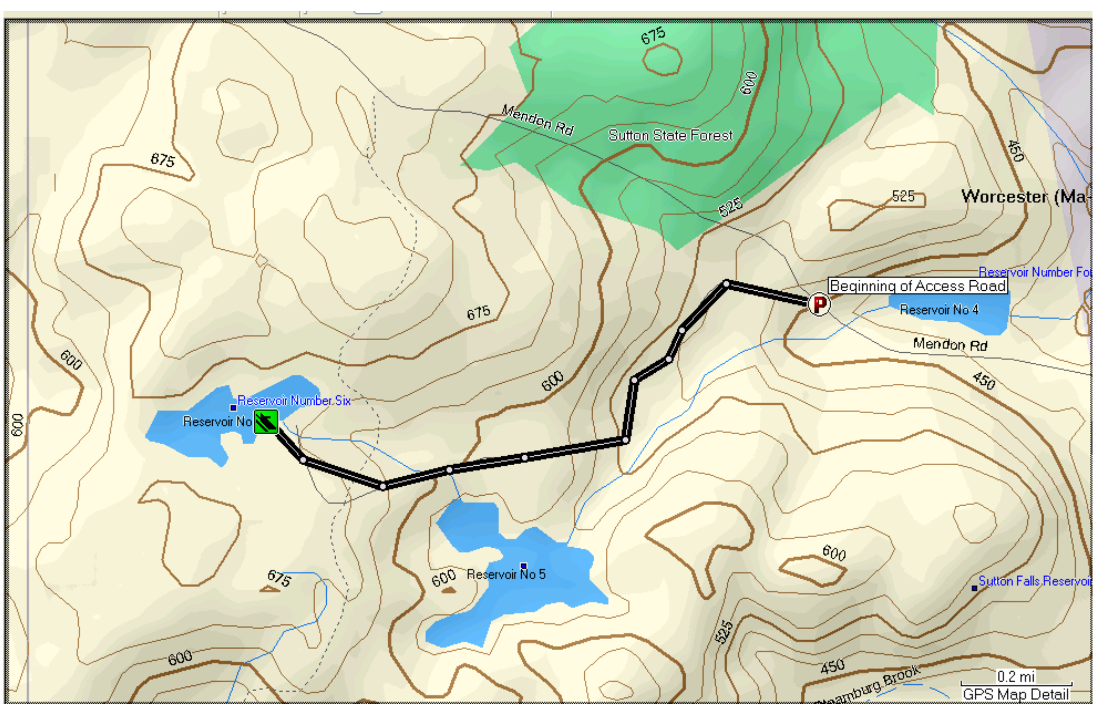
- Head West on MA-140N/W Central St - **2.6 mi**
- Slight right at S Main St - **299 ft**
- Take the 1st left onto MA-140 N/Mendon St; Continue to follow MA-140 N - **4.1 mi**
- Slight left at Cape Rd - **0.5 mi**
- Continue onto Elm St - **0.2 mi**
- Turn left at MA-16 W/Main St; Continue to follow MA-16 W - **3.0 mi**
- Turn right at Hartford Ave W - **4.2 mi**
- Turn right at MA-122 N/N Main St - **0.5 mi**
- Take the 2nd left onto Linwood Ave - **1.6 mi**
- Continue onto Main St/Whitinsville Rd; Continue to follow Main St - **1.4 mi**
- Turn right at Mendon Rd East Section/Prentice Rd/Whitinsville Rd; Continue to follow Whitinsville Rd - **0.8 mi**
- Continue onto Mendon Rd - **1.0 m**
- Park in front of gate on left - **END**

In 2010, no markings or signs indicated the access road to Reservoir #6, although in earlier years "#6 Res" was painted on a rock at the gate. Use of the GPS was imperative to find the correct access road. After finding and parking in front of the gated access road, follow the access road on foot to Reservoir # 6.

Parking at access road

Launch Site Description

After parking in front of the gate off of Mendon Rd, hike about 1.2 miles on the access road to the launch site. Hike along the gravel/broken asphalt road, past the Sutton Police Department Firing Range. When the road splits, bear right up the hill. The road keeps curving uphill and ends at the reservoir. It is about a 25 minute walk. Anywhere along the southwestern shore should provide suitable launch conditions.



Sutton, Massachusetts

Coordinates:

Sampling Point:
N 42.114399
W 71.742798

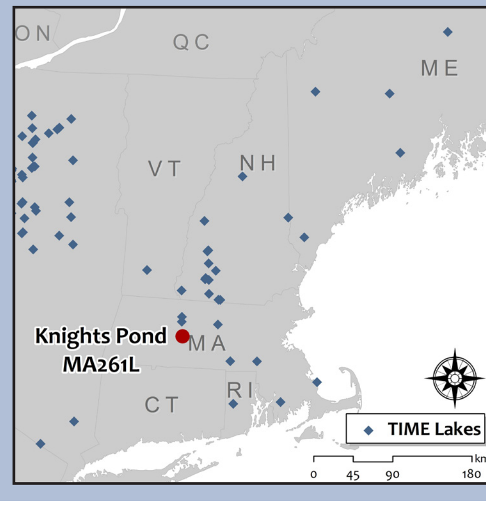
Launch Point:
N 42.11444
W 71.74110

Parking:
N 42.11749
W 71.72160

Knights Pond

Lake ID: MA261L

Other IDs/names: WBID: MA36077



Lake description

Knights Pond is a small and fairly scenic reservoir in a suburban/rural area of Hampshire County, Massachusetts. As a reservoir, its use by the public is closely monitored and regulated.

Knight's Pond is dammed (Dam NATID: MA00485); its outlet (Jabish Brook) at the southern end of the pond feeds the Springfield Reservoir via canal. The dam was reportedly in poor condition in 2005, and was rated a "significant hazard" in 2012.[1] According to deeds from the 1891 taking of the land around Knights Pond, a sawmill (probably powered by water) existed on one of the properties at Knights Pond.[2] According to the Springfield Water and Sewer Commission, the spillway elevation is 928 feet, the crest of the dam is 931.3 feet, the dam is recorded at 19 feet high, and the storage volume is 270 acre-feet at spillway elevation.[3]

To the north of Knights Pond, BioMap2 has identified a Critical Natural Landscape, "large natural landscape blocks that are minimally impacted by development"[4] The southern end of the pond borders protected open space.[5] There is one certified vernal pool within 100 m of Knights Pond and several potential vernal pools in the vicinity.[5]

The forest surrounding the lake is largely coniferous, and has a somewhat open canopy on the shoreline. Terrain has little relief; the pond is surrounded by low, rolling, forested hills.

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992 and1994. Zooplankton species richness in Knights Pond was slightly less than the 25th percentile for all EMAP lakes.[5]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[6] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: There are no known survey data on presence or extirpation. No fish data were listed in EMAP data tables.[5]

Birds: Breeding birds were not listed in EMAP data tables.[5]

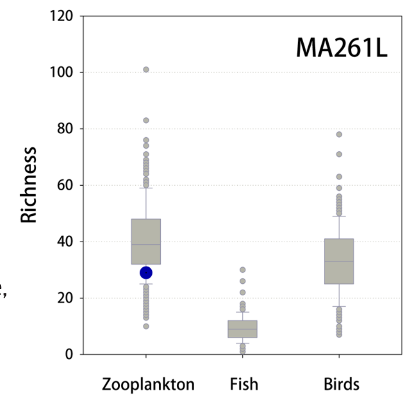


Figure MA261L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[5] (gray box plot) and for this lake, Knights Pond (blue dot).

Bathymetry

There is no recent bathymetric map for Knight's Pond, but Kimball (1972) published one in a study of copper in the pond.[8]

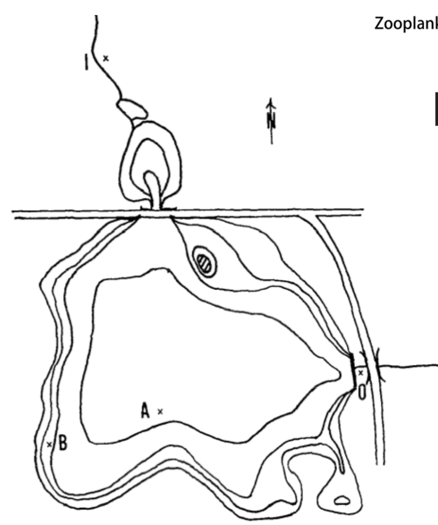


Fig. 1. Map of Knights Pond and sampling locations. Inlet—I; Outlet—O; Station A and B—A and B. The contour interval is 1.2 m and the scale is 100 m.

Table MA261L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	14.8
Watershed area (ha)	404.5
Mean depth (m)	2.7[8]
Max depth (m)	4.3[8]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	280
Maximum watershed elevation (m)	375
Mean watershed slope (degrees)	3.1
Landcover (% of total watershed)	
Open water	4.7
Developed, open space and low-intensity (<50% impervious)	2.5
Deciduous forest	70.0
Evergreen forest	4.1
Mixed forest	5.1
Shrub & Herbaceous	1.6
Agriculture (hay, cultivated)	0.3
Wetlands	10.8
Mean Impervious surface (% of total watershed)	0.2
Bedrock Geology	
Lower Paleozoic granitic rocks	

Table MA261L.2. Long-term chemistry for Knight's Pond, 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.95	0.36	13
ClpH	pH units	5.72	0.36	13
ANC	$\mu eq \cdot L^{-1}$	12.6	8.4	13
DOC	$mg \cdot L^{-1}$	4.05	1.05	13
Cond	$\mu S \cdot cm^{-1}$	44.3	9.2	13
Color*	Pt-Co units	15|34	9|15	7|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	66.3	6.9	13
Mg^{2+}	$\mu eq \cdot L^{-1}$	31.1	3.4	13
K^{+}	$\mu eq \cdot L^{-1}$	10.6	2.0	13
Na^{+}	$\mu eq \cdot L^{-1}$	241.0	59.7	13
Al (Total)	$\mu g \cdot L^{-1}$	57.9	39.9	13
SO_4^{2-}	$\mu eq \cdot L^{-1}$	83.1	18.8	13
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	2.0	13
Cl^{-}	$\mu eq \cdot L^{-1}$	240.6	74.7	13
SiO_2	$mg \cdot L^{-1}$	2.38	1.79	11
Total P	$\mu g \cdot L^{-1}$	8.6	3.0	6
Total N	$\mu g \cdot L^{-1}$	250	76	10

* Color is displayed as True|Apparent

Site disturbance & considerations

- Contact Springfield Water and Sewer Commission before sampling.

Sampling history and other studies at this lake

Knights Pond was not cored in the 1991-1995 EMAP sediment survey. Its 1994 EMAP sample was taken by helicopter.

Knight's Pond was sampled in a study of copper chemistry during 11 months in 1971–1972.[8] The author notes that Knights Pond is "circular with an area of 15.8 ha, maximum depth of 4.3 m, mean depth 2.7 m, and total volume 4.42×10^8 liters. Runoff into the pond approximates 22×10^8 L•yr^{-1}. Winds are sufficient to prevent summer stratification. Extensive algal growths are absent and rooted vegetation is sparse."[8] pH was measured with a "portable meter" and ranged 3.7–5.8 through the period.[8]

Knight's Pond was sampled for major ion chemistry and acid-base status in spring and summer 1983, fall 2001, and spring, summer, and fall 2002 as part of Massachusetts' Acid Rain Monitoring (ARM) program, which is led by the Water Resources Research Center at the University of Massachusetts Amherst.[9] Samples are collected by citizen volunteers. In the summer samples, pH was 5.57 in 1983 and 5.73 in 2002, similar to that reported by EMAP and TIME in the early 1990s and 2002, respectively (Figure MA261L.2). Sulfate in the summer 1983 sample was 42 µeq/L, not consistent with early EMAP sampling of this lake (Figure MA261L.2). Knight's Pond was also sampled monthly at a second site from July 1983–April 1984.[9] pH was slightly depressed in winter and spring months, as is expected for ponds that experience ice cover and snowmelt in the Northeast.

Knights Pond was assessed in 1998 and 2004 for the Massachusetts Integrated List of Waters (Clean Water Act Sections 303d and 305b). Assessed uses were secondary contact and aesthetics; the pond supported these uses.[2] Samplers noted that there were "Patches of floating leaf plants in the north, northwest, and southeast parts of the lake; emergents occasional around shore".[2] Trophic state was not assessed.

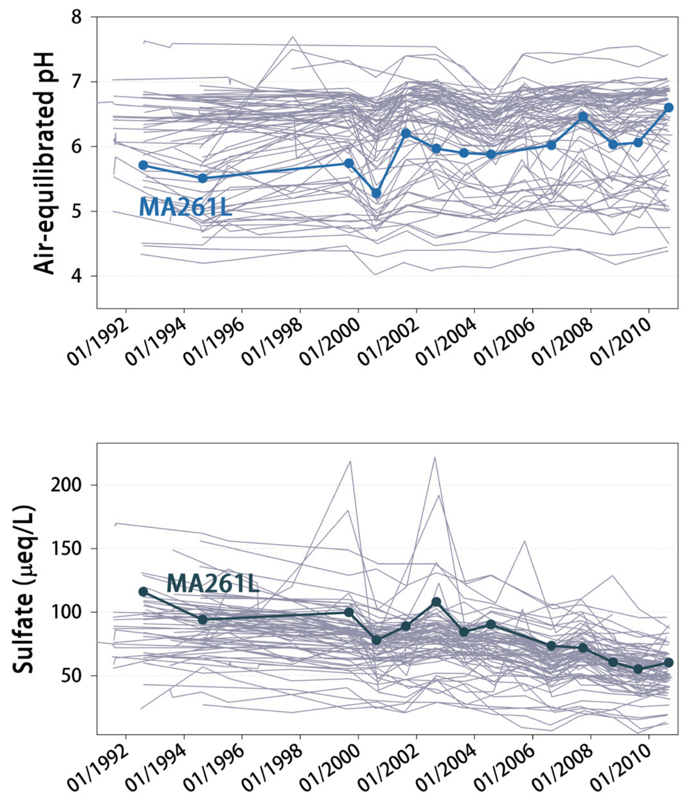


Figure MA261L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Knights Pond (thick blue line) began with moderately low pH that has gradually increased through time, and steadily declining sulfate concentrations.

References

[1] MA DCR, 2012.

[2] Weinstein *et al.*, 1998.

[3] Borgatti, D., pers. comm. Operations Director, Springfield Water and Sewer Commission, Agawam, MA, pers. comm. February 25, 2013.

[4] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.

[5] MassDEP, 2013.

[6] US EPA, 2012.

[7] Nelson *et al.*, 2011.

[8] Kimball, 1973.

[9] Massachusetts Acid Rain Monitoring (ARM) Program, 2013.

Photo date: August 2012 • Credit: A. Baumann

Site access

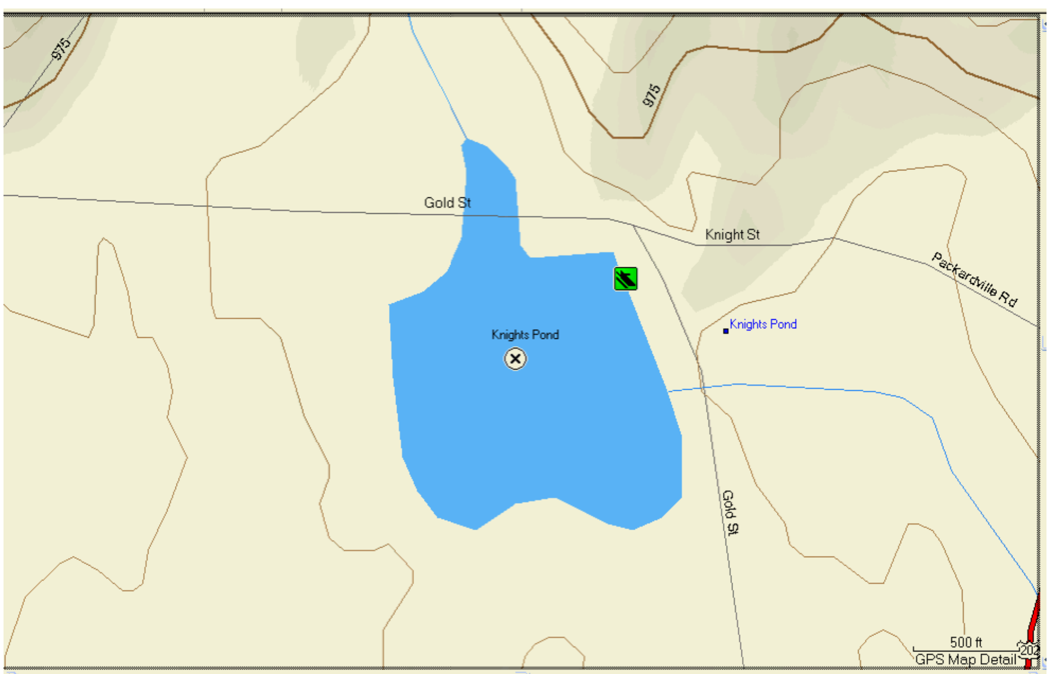
From I-495 1 hour 15 min, 121.4 mi

- Head southwest on I-495 S
- Take exit 29B to merge onto MA-2 W toward Leominster **- 42.7 mi**
- Merge onto US-202 S/Daniel Shays Hwy via the ramp to Amherst/Belchertown **- 17.6 mi**
- Turn right at Knights St **- 0.4 mi**
- Turn left onto Gold St **- 390 ft**
- Park along right side (west side) of Gold St where the earthen dam begins (Launch from Gold St shore) **- END**

As an alternative to Route 495, take the Massachusetts Turnpike (Mass Pike) to Palmer.

Launch Site Description

After parking on the west side of Gold St, walk north on Gold St about 100ft. Launch from underneath the white pines where the bedrocks meet the pond. This seemed to be the most accessible launch in 2010.



Belchertown, Massachusetts

Coordinates:

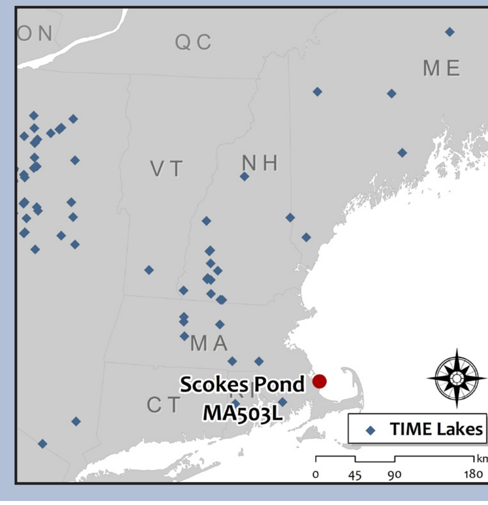
Sampling Point:
N 42.35168
W 72.41318

Launch Point:
N 42.35270
W 72.41126

Scokes Pond

Lake ID: MA503L

Other IDs/names: Scoux Pond

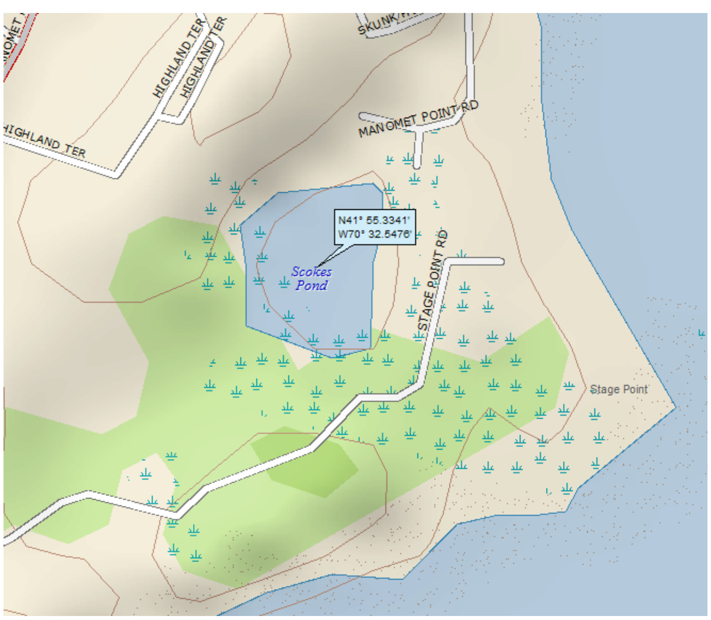


Lake description

Scokes Pond is located on a point only about 500 feet from the Atlantic Ocean to the north, east, and south. Land use surrounding the pond is complicated. There are cultivated and natural cranberry bogs, high to medium density residential development, commercial development, some protected open space, one certified and several potential vernal pools,[1] and many major roads all within 500 m of the pond. The residential area surrounding much of the pond is comprised of thick forest and shrubby vegetation.

Scokes Pond is listed as a BioMap2 Aquatic Core Habitat, (ID 713) for its Priority & Exemplary Natural Community: Coastal Plain Pondshore ("globally rare herbaceous communities of exposed pondshores with a distinct coastal plain flora"), and for Species of Conservation Concern: the globally rare Plymouth Gentian (*Sabatia kennedyana*), which flowers during the TIME lakes sampling season, July–September).[2]

The buffer zone around the pond is considered a Priority Natural Community (ID 424).[2] According to NHESP, water levels change with the water table, typically leaving an exposed shoreline in late summer where many rare species grow. This example of Coastal Plain Pondshore is in fair condition, and is degraded by the dense development surrounding the pond.



Biota

Zooplankton: Sampled in 1993, species richness in Scokes Pond was slightly greater than the median for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in 2012 as part of mercury research.[4] Individuals of the families *Corduliidae* and *Libellulidae* were collected.

Fisheries: Fish species richness (sampled in 1993) was very low, compared to all EMAP lakes.[3] Fish mercury concentrations were slightly lower than the 25th percentile across all EMAP lakes (Fig. MA503L.2).[3]

Birds: Breeding bird richness (1993 sampling) was very low, compared to all EMAP lakes.[3]

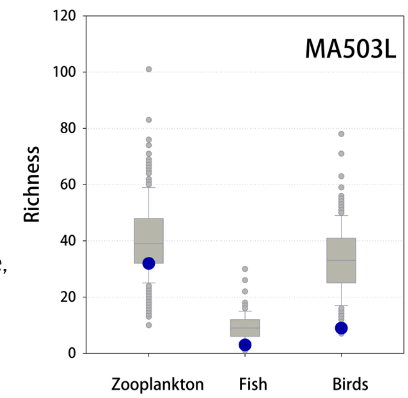
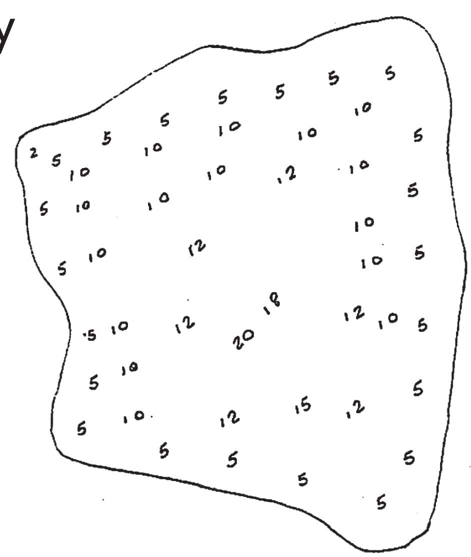


Figure MA503L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, Scokes Pond (blue dot).

Bathymetry



Scokes Pond bathymetry, 1970s.[5] This source reported:

Max depth=6.1 m
Mean depth=3.4 m
Surface area=2.4 ha
Volume=81,410 m^3

Table MA503L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	2.2
Watershed area (ha)	15.7
Mean depth (m)	3.4[5]
Max depth (m)	6.1[5]
Drainage class	seepage
Number of inlets	0
Number of outlets	0
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	3
Maximum watershed elevation (m)	22
Mean watershed slope (degrees)	5.7
Landcover (% of total watershed)	
Open water	14.9
Developed, open space and low-intensity (<50% impervious)	8.0
Developed, medium to high density (≥50% impervious)	2.9
Deciduous forest	19.5
Evergreen forest	12.6
Shrub & Herbaceous	11.5
Agriculture (hay, cultivated)	24.7
Wetlands	14.8
Mean Impervious surface (% of total watershed)	2.7
Bedrock Geology (% of total watershed)	
• Pleistocene (95%) • no data (5%)	

Table MA503L.2. Long-term chemistry for Scokes Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

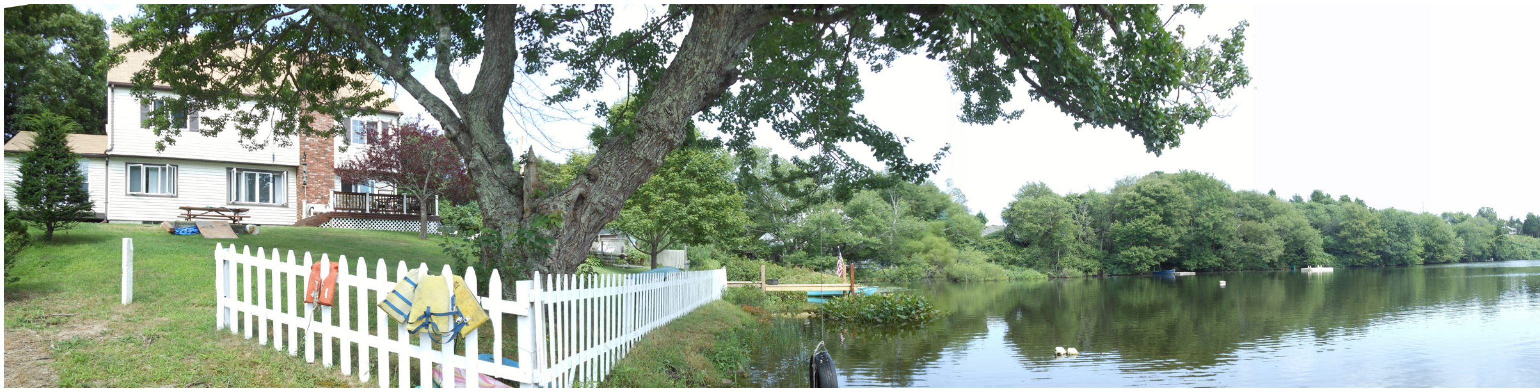
Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.73	0.24	12
ClpH	pH units	6.29	0.27	12
ANC	$\mu eq \cdot L^{-1}$	61.9	14.4	12
DOC	$mg \cdot L^{-1}$	5.85	0.65	12
Cond	$\mu S \cdot cm^{-1}$	110.6	15.3	12
Color*	Pt-Co units	36|37	11|10	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	61.6	19.9	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	160.2	19.5	12
K^{+}	$\mu eq \cdot L^{-1}$	57.2	7.5	12
Na^{+}	$\mu eq \cdot L^{-1}$	636.7	70.8	12
Al (Total)	$\mu g \cdot L^{-1}$	31.6	5.8	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	72.1	30.0	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	751.9	99.4	12
SiO_2	$mg \cdot L^{-1}$	0.33	0.12	10
Total P	$\mu g \cdot L^{-1}$	38.0	10.4	5
Total N	$\mu g \cdot L^{-1}$	388	86	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Be certain to clean boats and equipment carefully before entering this pond, which is an area with a plant species that is globally rare (Plymouth Gentian).[2]

Plymouth gentian. Photo: Sally & Andy Wasowski, Lady Bird Johnson Wildflower Center.



Sampling history and other studies at this lake

Scokes Pond was cored in 1993 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Scokes Pond, diatom-inferred pH was 7.39 in the bottom section (post-1850), and also 7.39 in the top (recent) section of the core.[3]

In the 1970s, ponds in the Town of Plymouth were the subjects of a series of reports documenting baseline conditions. Scokes Pond was included in one report, and listed as a warm-water kettlehole.[5] Aquatic plants at the time were white water lily (*Nymphaea*), pickerel weed, bulrush sedge, water milfoil (*Myriophyllum*), bladderwort, and filamentous green algae. Plant locations at the time are mapped in the report. Some water chemistry was taken in the pond (nutrients, metals). Secchi depth was reported as 5–7 ft (~2 m). In 2004, Secchi depth measured by the TIME sampling team averaged 1.55 m. In the 1970s, the lake was reported as non-stratified. The authors listed the pond as groundwater-fed, and eutrophic and the authors suggested caution if new human development was planned near the lake.

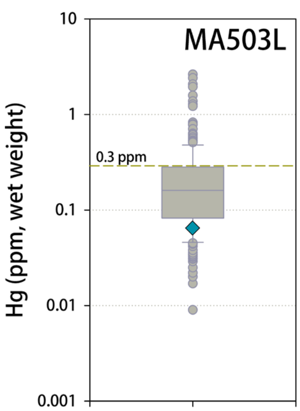
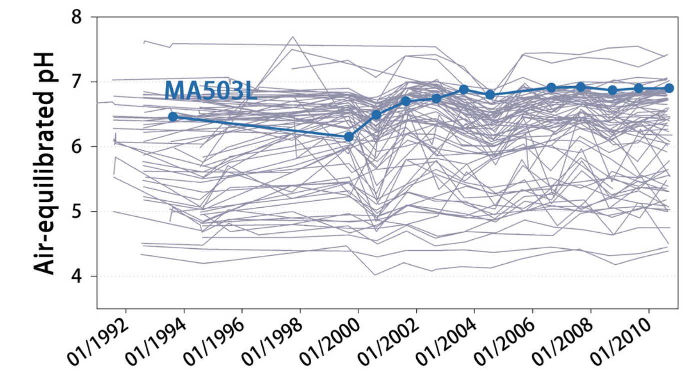


Figure MA503L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot). The value 0.3 ppm is the US EPA advisory level.

References

[1] MassDEP, 2013.
[2] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.
[3] US EPA, 2012.
[4] Nelson *et al.*, 2011.
[5] Lyons-Skwarto Associates, 1980.



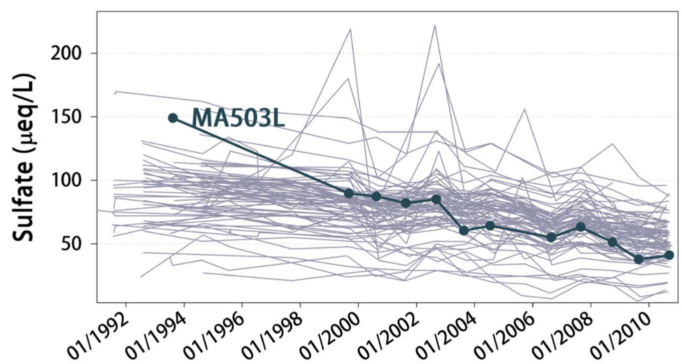
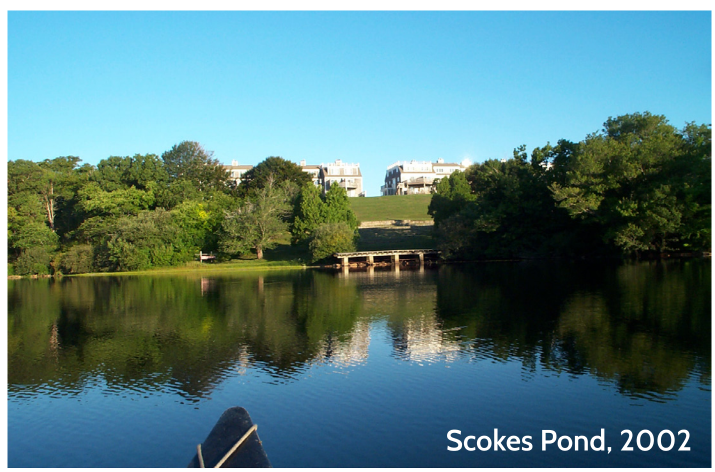


Figure MA503L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Scokes Pond (thick blue line) has had among the highest pH but sulfate has ranged from relatively high to relatively low in the TIME dataset.



Site access

From MA-3 — 14 min, 6.8 mi

Take exit 4 on the left for Plimoth Plantation Highway toward Manomet - **0.7 mi**
Merge onto Plimoth Plantation Hwy - **1.4 mi**
Continue onto Massachusetts 3A S/Warren Ave; Continue to follow Massachusetts 3A S - **3.6 mi**
Turn left at Manomet Point Rd (across from Hannaford) - **1.0 mi**
Turn right at Osprey Ln - **0.1 mi**
Turn right at Skunk Hollow Rd (becomes a dirt road) - **397 ft**
Bear left at fork onto Montrose Dr (Private Drive) - **END**

Plymouth, Massachusetts

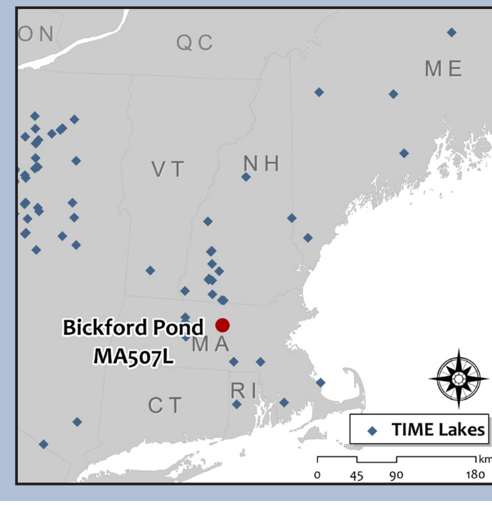
Coordinates:

Sampling Point:
N 41.92259
W 70.54225

Launch Point:
N 41.92292
W 70.54200

Bickford Pond

Lake ID: MA507L
Other IDs/names: WBID: MA36015

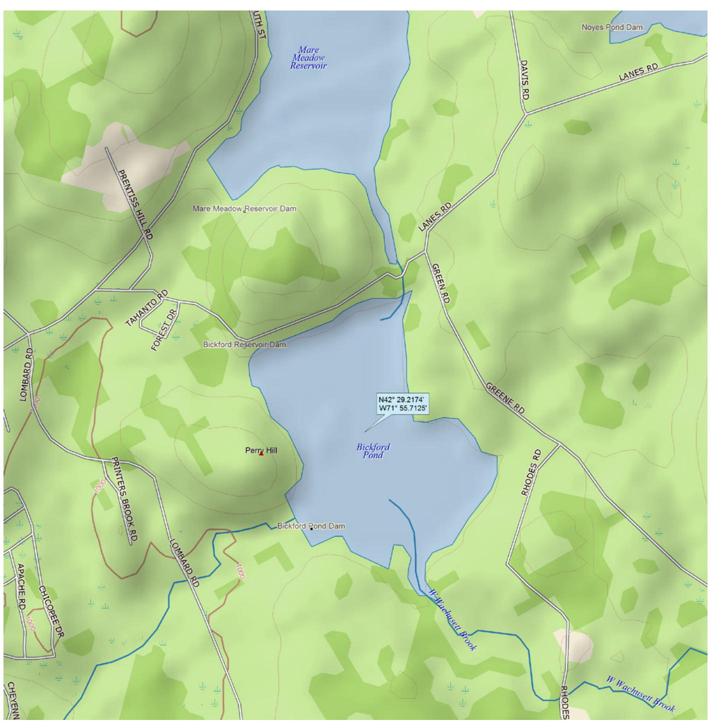


Lake description

Bickford Pond is large public water supply reservoir; the pond and its inlet streams are located within a Surface Water Protection Area and protected open space.[1] Several certified and potential vernal pools surround the pond. A Community Surface Water Intake is located at the pond, as well as other intakes in nearby ponds and aquifers. The Pond is between the relatively large Wachusett Mountain State Reservervation to the east, which includes popular hiking areas and a commercial ski area, and Hubbardston Wildlife Management Area, ~1,000 m to the west of the Pond. Local roads traverse the area. Fishing is allowed at the pond.

The pond is listed as Aquatic Core habitat for the common loon (*Gavia immer*), a species of special concern.[2] The area surrounding the pond has also been designated a Critical Natural Landscape because of the Aquatic Core, Wetland Core, and Landscape Block characteristics; it is a largely intact block of predominantly natural vegetation.[2]

There is an earthen dam, built in 1970, at Bickford Pond, on West Wachusett Brook (NATID: MA01021) and a dike on the East Branch of the Ware River (NAT ID: MA01022).[3] Both are listed as "High hazard" features.



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1993. Zooplankton species richness in Bickford Pond was slightly lower than the 25th percentile for all EMAP lakes.[4]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected.

Fisheries: No fish data were listed in EMAP data tables,[4] or found in other sources.

Birds: Breeding birds were not listed in EMAP data tables.[4]

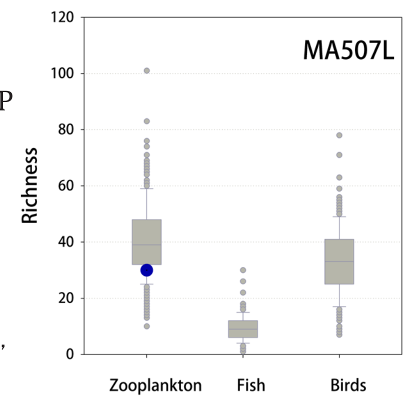
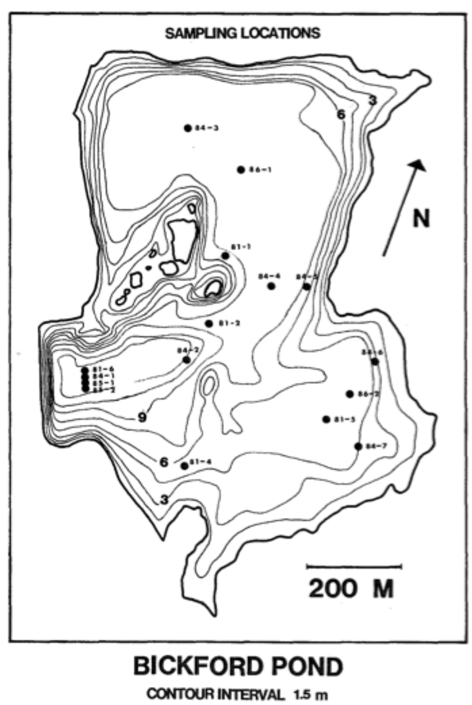


Figure MA507L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake, Bickford Pond (blue dot).



Bathymetry

Benoit (1988) included the bathymetric map at left, and provided the following data:[6]

Lake volume $=3.37\times10^{6}$ m^3

Mean water residence time =0.23 y

When stratified, epilimnetic residence time is ~80 d

Table MA507L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	62.5
Watershed area (ha)	839.1
Mean depth (m)	5.7[6]
Max depth (m)	13[6]
Drainage class	reservoir
Number of inlets	2[6]
Number of outlets	2[6]
Flow alteration	dam; dike; pumped
Topography	
Minimum watershed elevation (m)	308
Maximum watershed elevation (m)	526
Mean watershed slope (degrees)	4.8
Landcover (% of total watershed)	
Open water	7.9
Developed, open space and low-intensity (<50% impervious)	4.0
Deciduous forest	43.2
Evergreen forest	10.2
Mixed forest	17.2
Shrub & Herbaceous	0.2
Agriculture (hay, cultivated)	2.6
Wetlands	15.0
Mean Impervious surface (% of total watershed)	0.2
Bedrock Geology (% of total watershed)	
• Devonian eugeosynclinal (69%) • Middle Paleozoic granitic rocks (31%)	

Table MA507L.2. Long-term chemistry for Bickford Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.65	0.20	12
ClpH	pH units	6.30	0.27	11
ANC	$\mu eq \cdot L^{-1}$	37.6	12.4	12
DOC	$mg \cdot L^{-1}$	3.26	0.48	12
Cond	$\mu S \cdot cm^{-1}$	44.9	4.4	12
Color*	Pt-Co units	8|19	6|12	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	109.4	7.6	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	35.3	2.3	12
K^+	$\mu eq \cdot L^{-1}$	17.4	1.7	12
Na^+	$\mu eq \cdot L^{-1}$	206.5	28.0	12
Al (Total)	$\mu g \cdot L^{-1}$	11.0	9.2	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	97.9	19.4	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^-	$\mu eq \cdot L^{-1}$	218.1	27.1	12
SiO_2	$mg \cdot L^{-1}$	1.77	1.04	10
Total P	$\mu g \cdot L^{-1}$	5.4	2.8	5
Total N	$\mu g \cdot L^{-1}$	189	59	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Contact Fitchburg Water Lab to unlock the gate.
- Steer clear of any loon nesting areas.

Benoit (1988) detailed Bickford Pond's history: "The history of the lake can be divided into three separate periods. During the first, the lake, probably of glacial origin, occupied a depression that corresponds roughly to the area deeper than 8 m on the bathymetric map...That lake gradually filled in, producing a bog whose peat-like material is still found on the bottom of the northern part of the present-day lake. In the second stage, sometime during the last century, a stone dam was constructed...flooding the bog to a depth of about 2 m...The most recent period began in 1970 when the lake was enlarged to its present size by the addition of two earthen dams. Enlargement also captured a much larger watershed, causing streams to begin draining into the lake and presumably causing a large increase in the input of allochthonous material."[6]

Sampling history and other studies

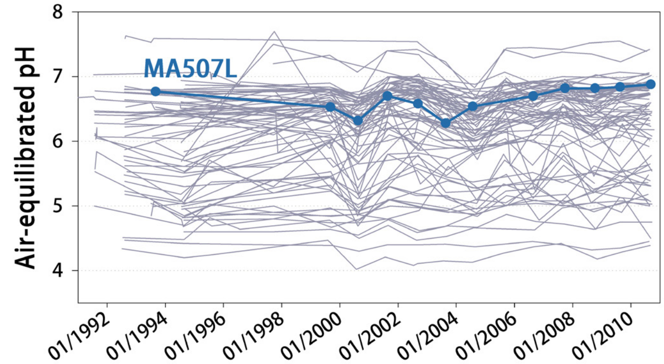
Bickford Pond was not cored in the 1991-1995 EMAP sediment survey.

Water from Bickford Pond is pumped to Mare Meadow Reservoir (both in the Chicopee River Basin), and then into Meetinghouse Reservoir, which resides in the Nashua River Basin.[7] Bickford Pond is an emergency back-up water supply. and has apparently never been used; Mare Meadow Reservoir is used approximately four to six weeks each year during periods of high demand.[7]

Bickford Pond is a Class A waterbody and was assessed in 1998 and 2004 for the Massachusetts Integrated List of Waters (Clean Water Act Sections 303d and 305b). Assessed uses were secondary contact and aesthetics; the pond supported these uses.[8,9] In 2002, 2004, 2006, and 2010, the outlet from Bickford Pond to Barre, a 12.9 mile segment of the East Branch of the Ware River, was listed as impaired due to low dissolved oxygen; prior to 2010, the segment was also impaired due to organic enrichment.[9]

Bickford Pond was sampled for major ion chemistry and acid-base status approximately quarterly from late 1984–1990, and twice per year in 1992–3 and 2001–2 as part of Massachusetts' Acid Rain Monitoring (ARM) program, which is led by the Water Resources Research Center at the University of Massachusetts Amherst.[10] Samples are collected by citizen volunteers. In the summer samples, mean pH was 6.28 in the 1986–92 period, and 6.45 in 2001–2, similar to values reported by EMAP and TIME (Figure MA507L.2). Sulfate in summer samples 1986–89 averaged 133 μeq/L, and in summer 1992 was 113 μeq/L, consistent with early EMAP sampling of this lake (Figure MA507L.2).[10]

Two PhD dissertations from MIT students involved Bickford Pond, and reported that it was oligotrophic.[6,11] pH was ~6.5, suggesting that the pond was not affected by acidic deposition.[6,11] Published papers reported on the sampling of ^{210}Pb and ^{210}Po in Bickford Pond, and implications for dating paleo archives.[12,13] Benoit (1988) provided excellent detail about the lake in the dissertation, which is available online.[6]



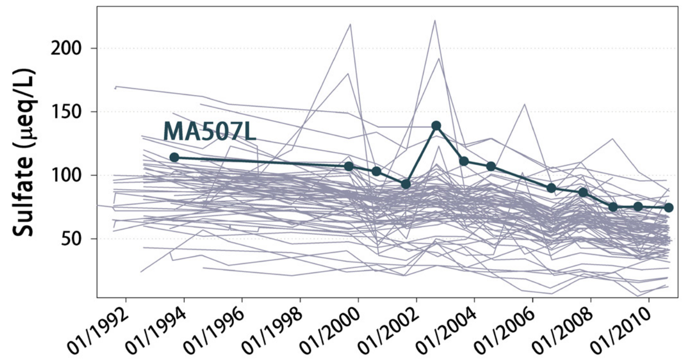


Figure MA507L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Bickford Pond (thick blue line) has had circum-neutral pH and among the highest sulfate measurements in the TIME dataset.

References

[1] MassDEP, 2013.
[2] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.
[3] Massachusetts Department of Conservation and Recreation, 2012.
[4] US EPA, 2012.
[5] Nelson *et al.*, 2011.
[6] Benoit, 1988.
[7] Gomez and Sullivan Engineers, 2004.
[8] Weinstein *et al.*, 1998.
[9] US EPA, 2013.
[10] Massachusetts Acid Rain Monitoring (ARM) Program, 2013.
[11] Eshleman, 1985.
[12] Benoit and Hemond, 1987.
[13] Benoit and Hemond, 1990.

Photo date: August 2012 • Credit: A. Baumann

Site access

From I-495 — 40 min, 27.3 mi

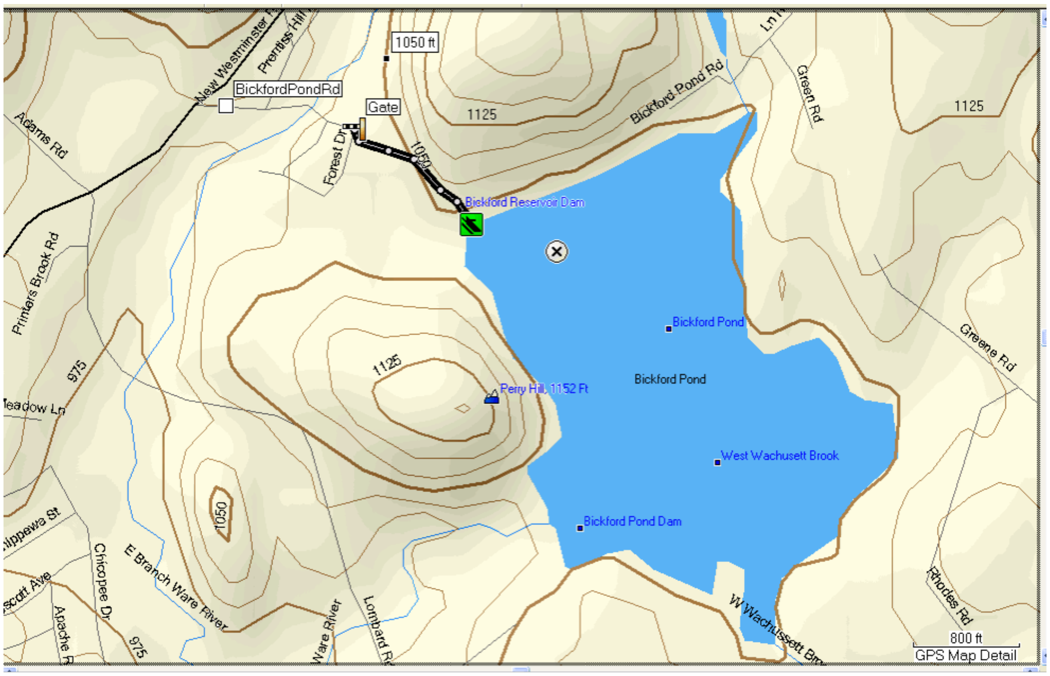
Head southwest on I-495 S
Take exit 29B to merge onto MA-2 W toward Leominster - **21.7 mi**
Take exit 25 for Massachusetts 2A/MA-140 S toward Westminister/Princeton - **0.2 mi**
Turn right at MA-140 S/Massachusetts 2A W/State Hwy 2A W - **0.1 mi**
Take the 1st right onto Massachusetts 2A W/Main St/Seaver St
Continue to follow Massachusetts 2A W/Main St - **0.7 mi**
Turn left at South St (becomes New Westminster Rd) - **4.2 mi**
Turn left at Bickford Pond Rd (continue to gate) - **0.2 mi**
Continue through gate on access road - **0.2 mi**
Park at first grass clearing where Bickford Pond is visible on right - **END**

Launch Site Description

After parking in the grass clearing at the northwest corner of the pond proceed through the clearing to the edge of the pond. The launch area is flat and grassy with a slight drop down to the edge of the pond which has a sandy bottom with some rocks. This area allows for an easy launch and rinse point.


Photo: C. Schmitt, 2002


Photo: C. Schmitt, 2002



Hubbardston & Princeton, Massachusetts

Coordinates:

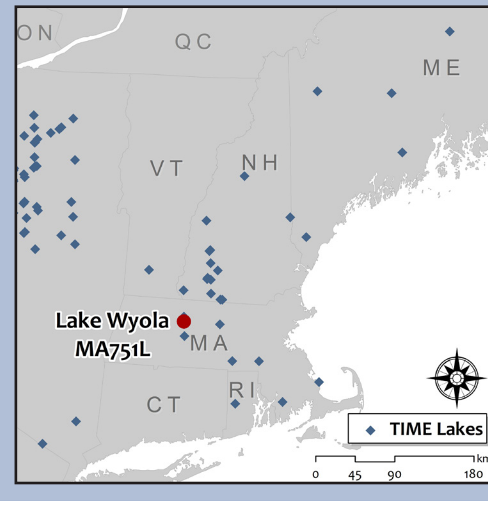
Sampling Point:
N 42.48916
W 71.93181

Launch Point:
N 42.48972
W 71.93422

Lake Wyola

Lake ID: MA751L

Other IDs/names: PALIS: 34103; WBID: MA34103



Lake description

Lake Wyola is a Massachusetts Great Pond with a surface area of 52 hectares. The lake has a high amount of residential development, including homes and seasonal cottages. Along the northern shore, off of Lakeview Road, is Lake Wyola State Park which offers a public recreation area including a swimming beach, campground, and paved boat ramp located off Locke's Point Road; all popular with recreational users in summer.

There are two non-community groundwater well intakes along the northern shore of the pond, with small wellhead protection zones.[1] The earthen dam on the western outlet (Sawmill River) of the Lake was originally constructed in 1883, by one report doubling the size of the lake. In 2009, the dam was replaced. The lake level is periodically drawn down to control aquatic plants; macrophyte abundance was high near the boat ramp and moderate near the dam in a 2010 survey.[2] Substrate is sand and gravel with cobble in shallow areas, and gyttja in deeper areas.[2]

Although listed as a Critical Natural Landscape (ID 1063), Aquatic Core Buffer,[3] Lake Wyola is impaired, appearing on the 1996 and 1998 303d list and 2006 Integrated List of Waters, Category 4a, due to nutrients, organic enrichment/low DO and noxious aquatic plants; a TMDL (ID 653) has been completed and approved.[4,5] The implementation plan recommends BMPs for erosion and sedimentation control, and development of a septic system management plan.[4]

Biota

Zooplankton: Sampled in 1994, species richness in Lake Wyola was near the median for all EMAP lakes.[6]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[7] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected. Lake Wyola is identified as Core Habitat (ID 2252) for Species of Special Concern: New England bluet (*Enallagma laterale*), a damselfly.[3]

Fisheries: Fish species richness in the 1994 EMAP sampling was at the 75th percentile for all EMAP lakes.[6] Nine species - including Species of Special Concern bridle shiner (*Notropis bifreantus*) - were documented in a 1978 summer survey.[3,8] Lake Wyola has been stocked in spring with brook trout and in fall with rainbow trout.[8]

Birds: 37 bird species were observed in the 1994 EMAP breeding birds survey.[6] Lake Wyola had greater than median bird species richness as compared to all EMAP lakes.

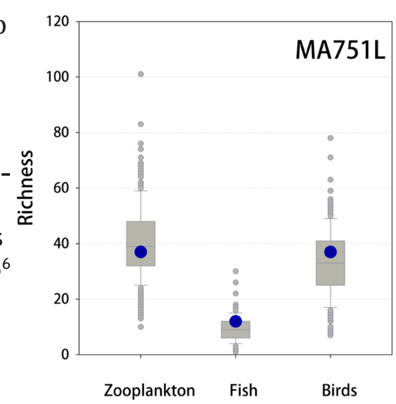


Figure MA751L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[6] (gray box plot) and for this lake (blue dots).

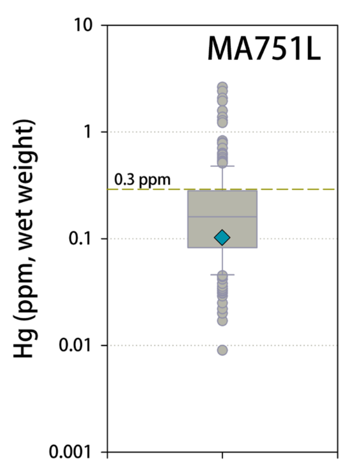


Figure MA751L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[6] (gray box plot) and for this lake (blue dot). Lake Wyola's yellow perch (*Perca flavescens*) sample value was 0.1 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.

Table MA751L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	51.1
Watershed area (ha)	1773.1
Mean depth (m)	3.35[8]
Max depth (m)	10.1
Drainage class	reservoir
Number of inlets	4
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	253
Maximum watershed elevation (m)	397
Mean watershed slope (degrees)	4.1
Landcover (% of total watershed)	
Open water	3.8
Developed, open space and low-intensity (<50% impervious)	6.2
Deciduous forest	33.5
Evergreen forest	32.4
Mixed forest	19.0
Agriculture (hay, cultivated)	0.9
Wetlands	4.0
Mean Impervious surface (% of total watershed)	0.5
Bedrock Geology (% of total watershed)	
• Lower Paleozoic granitic rocks (90%) • Ordovician volcanic rocks (10%)	

Table MA751L.2. Long-term chemistry for Lake Wyola, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.75	0.20	11
ClpH	pH units	6.32	0.39	11
ANC	$\mu eq \cdot L^{-1}$	48.8	13.6	11
DOC	$mg \cdot L^{-1}$	3.38	0.67	11
Cond	$\mu S \cdot cm^{-1}$	43.5	5.6	11
Color*	Pt-Co units	9|15	6|6	6|5
Ca^{2+}	$\mu eq \cdot L^{-1}$	95.8	9.5	11
Mg^{2+}	$\mu eq \cdot L^{-1}$	34.6	4.1	11
K^{+}	$\mu eq \cdot L^{-1}$	13.3	2.9	11
Na^{+}	$\mu eq \cdot L^{-1}$	215.4	26.7	11
Al (Total)	$\mu g \cdot L^{-1}$	17.8	16.9	11
SO_4^{2-}	$\mu eq \cdot L^{-1}$	93.5	10.4	11
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	11
Cl^{-}	$\mu eq \cdot L^{-1}$	201.9	37.3	11
SiO_2	$mg \cdot L^{-1}$	1.67	1.12	9
Total P	$\mu g \cdot L^{-1}$	5.9	1.6	5
Total N	$\mu g \cdot L^{-1}$	197	45	8

* Color is displayed as True|Apparent

Site disturbance & considerations

- Be aware of motor boats.
- Lake Wyola is most certainly affected by road salt with recent concentrations ~10 times the proposed threshold for lakes distant from the coast (Fig. MA751L.).[9] High road salt concentrations can complicate interpretation of long-term trends.

Sampling history and other studies at this lake

Lake Wyola was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[6] Based on the EMAP core at Lake Wyola, diatom-inferred pH was 6.76 in the bottom (pre-1850) section and 6.55 in the top (recent) section.[6]

Lake Wyola has a lake association that tests for *E. coli* at swimming beaches and has performed basic water quality monitoring since 1991 (DO, pH, clarity, conductivity). Measured *E. coli* concentrations have not exceeded safety limits. Secchi depth has ranged 4–7 meters between 2001–2011. Detailed lake profiles for temperature, DO, pH, and conductivity are available on the Association's web site, lakewyola.com.

The Sawmill River Watershed, which contains Lake Wyola, was the subject of a watershed assessment in 2002.[10] Although the lake itself was not assessed, some information regarding geology and the outlet of Lake Wyola are included.

Lake Wyola was assessed as part of a zebra mussel risk study in 2010 that included water chemistry, habitat and physical attributes, and plant surveys.[2] Wyola had among the lowest risk of zebra mussel invasion, due to low pH (6.17), low Ca (5 mg/L), and low alkalinity (<2 mg/L), as measured in 2010.[2]

Lake Wyola was sampled quarterly from fall 1985 through summer 1993 and two or more times per year from 2001–2009, with full ion chemistry analyzed for each sample, as part of Massachusetts' Acid Rain Monitoring (ARM) program, led by the Water Resources Research Center at the University of Massachusetts Amherst.[11] Samples are collected by citizen volunteers. ARM samples document slightly increasing pH and declining sulfate, consistent with EMAP/TIME results (Fig. MA751L.4). However, the ARM sampling in the earliest period of record (1985–93) reported considerably lower Cl than in the later ARM-sampled period (2001–2009) or in EMAP/TIME sampling (1992–2010, Cl mean=202 ± 37 μeq/L), suggesting an increasing signal from road salt in the more recent decade.[11]

Photo date: August 2012 • Credit: A. Baumann

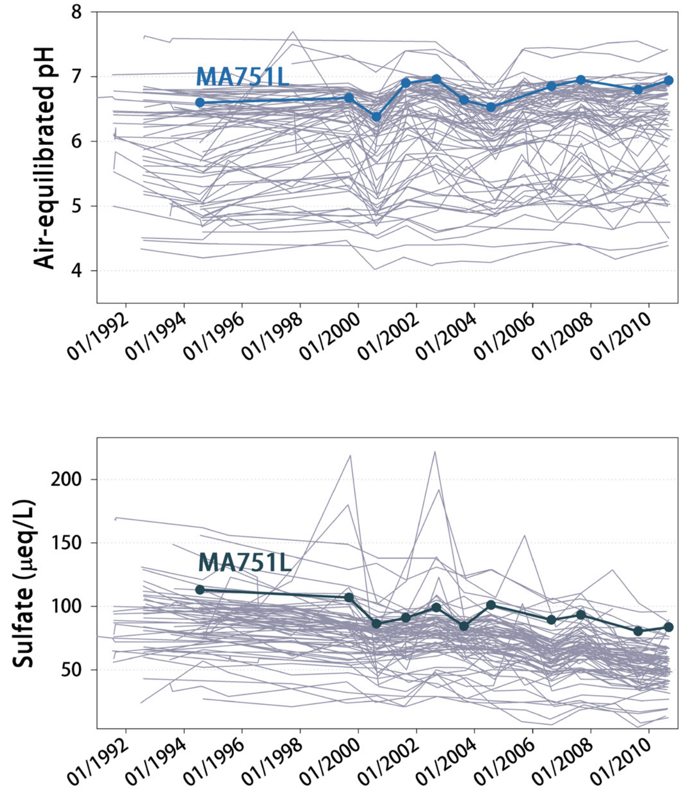


Figure MA751L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Lake Wyola (thick blue line) has consistently had among the highest pH and sulfate measurements in the TIME dataset.

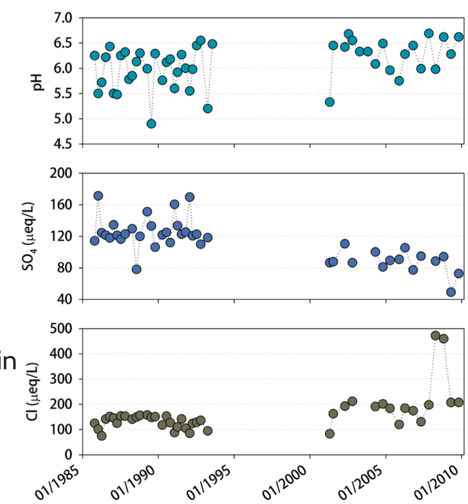


Figure MA751L.4. Results from Massachusetts ARM sampling, 1985-2009, for pH, sulfate, and chloride in Lake Wyola.

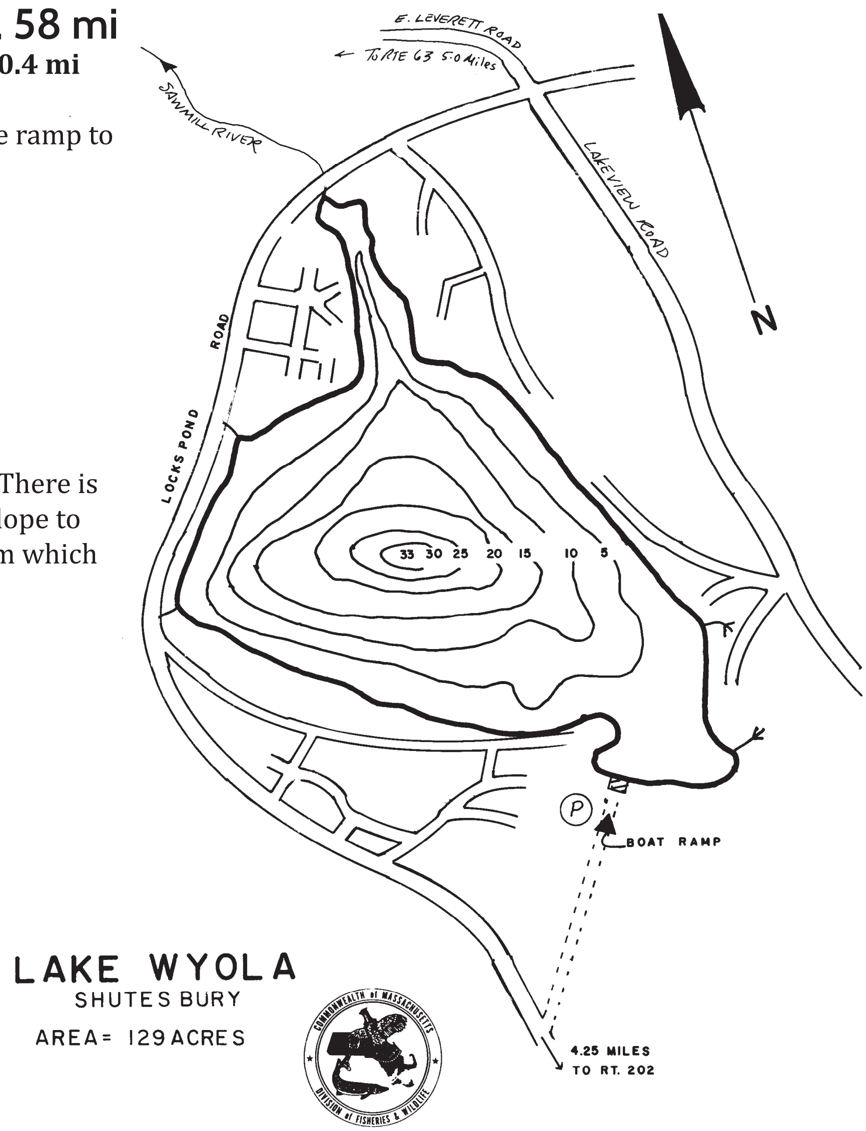
References

1 MassDEP, 2013.
2 Biodrawversity LLC, 2010.
3 MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.
4 Kennedy and Weinstein, 2000.
5 Carr and Kennedy, 2008.
6 US EPA, 2012.
7 Nelson *et al.*, 2011.
8 Massachusetts Division of Fisheries and Wildlife, 2013.
9 Rosfjord *et al.* 2007.
10 USDA-NRCS, 2002.
11 Massachusetts Acid Rain Monitoring (ARM) Program, 2013.

Site access

From I-495 1 hour 15 min, 58 mi

Head southwest on Exit 29B toward MA-2 W - **0.4 mi**
Merge onto MA-2 W - **42.2 mi**
Merge onto US-202 S/Daniel Shays Hwy via the ramp to Amherst/Belchertown - **10.5 mi**
Turn right at Prescott Rd - **0.8 mi**
Continue onto Cooleyville Rd - **0.4 mi**
Turn right at Wendell Rd - **2.1 mi**
Continue onto Locks Pond Rd - **1.4 mi**
Turn right at Randall Rd - **0.2 mi**
Park at boat launch - **END**



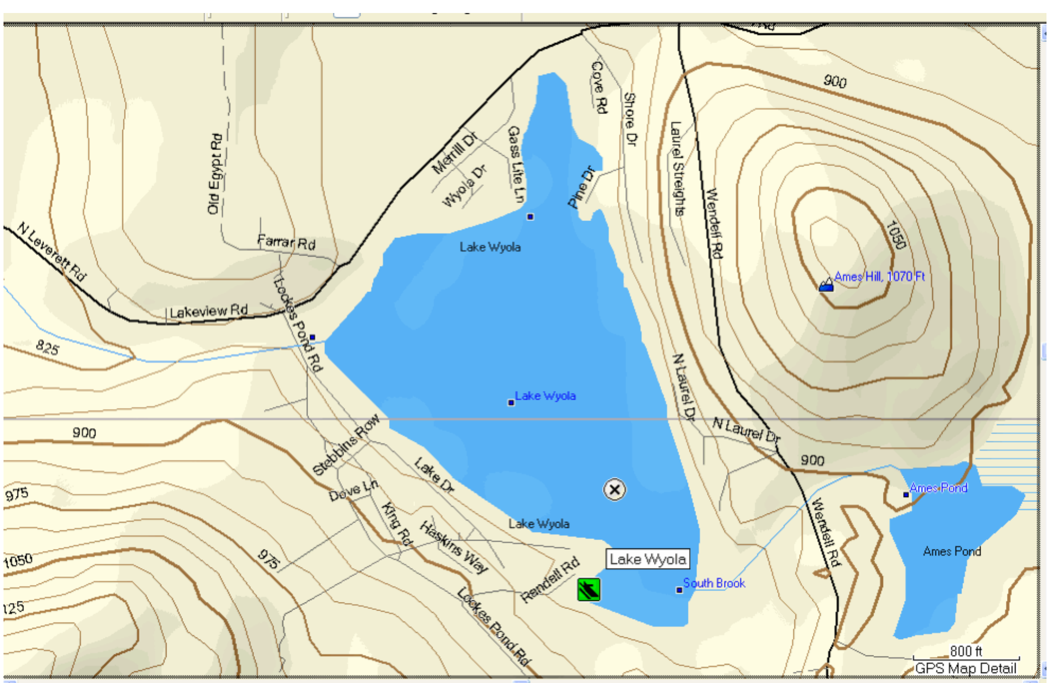
Launch Site Description

The launch area is a public paved boat launch. There is plenty of space to park a vehicle and a gentle slope to the lake that provides an easy access point from which to launch and rinse bottles.

Photo: C. Schmitt, 2003

Bathymetry

Mean depth: 11 feet[8]
Max. Depth: 33 feet

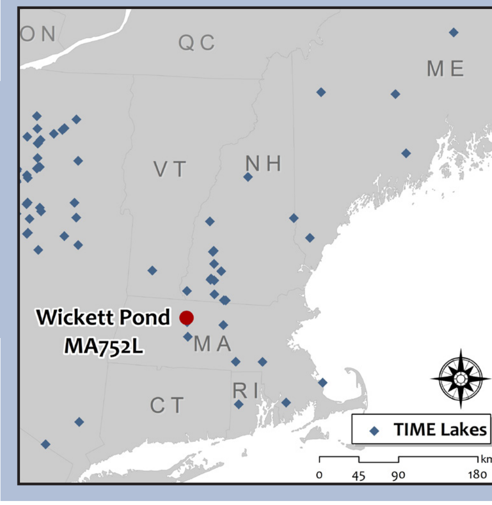


Shutesbury, Massachusetts

Coordinates:

Sampling Point:
N 42.49857
W 72.42770

Launch Point:
N 42.49648
W 72.42844



Wickett Pond

Lake ID: MA752L

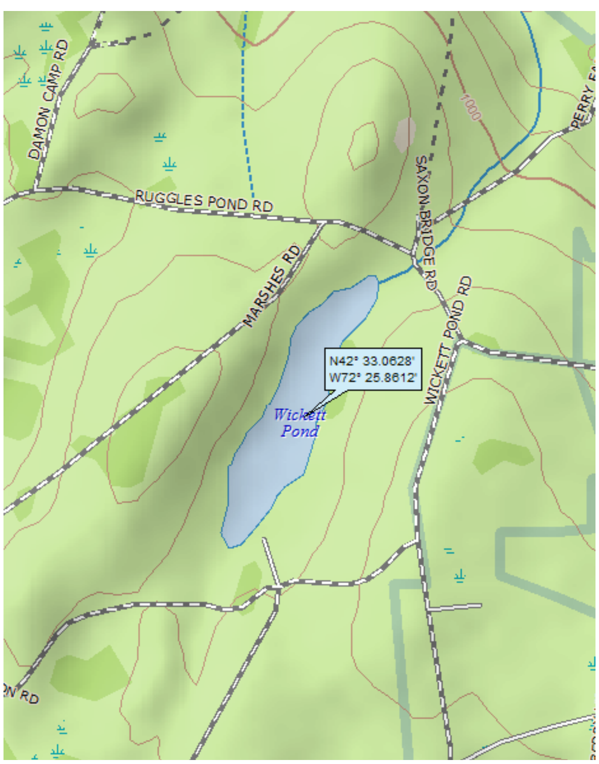
Other IDs/names: PALIS: 35102; WBID: MA35102

Lake description

Located within Wendell State Forest, Wickett Pond is a long and narrow pond surrounded by forest. Wendell State Forest has 7,566 acres of forested land with many hills, streams, ponds, trails and roads running though-out. There is a small boat ramp at the north end of the pond for public use.

The edges of the pond have large areas of emergent vegetation and as of 2010, it was evident that the area surrounding the pond was recently logged. Wendell State Forest lands were purchased in the 1920s and there had been significant burning across the area in the early 1900s.[1] A concrete spillway was built in the 1930s at the pond outlet[2] and a small unregulated dam still exists (NATID MA02524).[3] Paleolimnological reconstructions using a Wickett Pond sediment core indicated increases in sediment sccumulation rate concurrent with human settlement of the area.[2]

Wickett Pond is identified as Core Habitat (ID 2370) for Species of Special Concern: New England bluet (*Enallagma laterale*), a damselfly.[4] It is also listed as Critical Natural Landscape (ID 1138) as part of a Wetland Core Buffer that includes its connected hydrologic system.[4]



Biota

Zooplankton: Sampled in 1994, zooplankton species richness in Wickett Pond (19 species) was 10th lowest out of 336 EMAP lakes sampled.[5]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[6] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.
Fisheries: Five fish species in Wickett Pond were listed; this richness value was at the lower 25th percentile compared to all EMAP lakes that were sampled.[5]
Birds: 18 species of breeding birds were listed in EMAP data tables, among the lowest across all EMAP lakes sampled.[5]

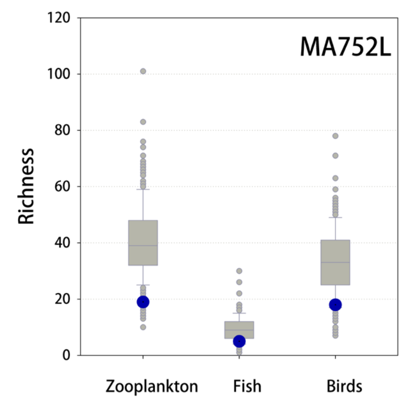


Figure MA752L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[5] (gray box plot) and for this pond, (blue dots).

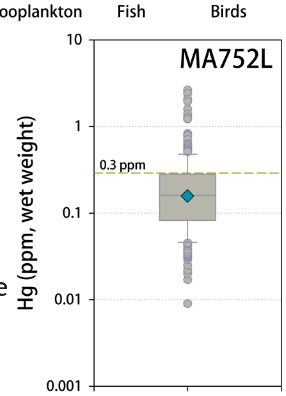


Figure MA752L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[5] (gray box plot) and for this lake (blue dot). Wickett Pond was sampled in 1994. Its yellow perch (*Perca flavescens*) sample value was 0.16 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.

Bathymetry

No bathymetric map is available for Wickett Pond. However, a maximum depth of 2.25 m and volume of 0.11×10^6 m^3 were reported during the September 1994 coring study.[2] At the 2012 sampling site, depth was 1.6 m. In 2002, Secchi depth was 1.6 m and touched the lake bottom.

Table MA752L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	12.8
Watershed area (ha)	105.4
Mean depth (m)	1.25[5]
Max depth (m)	2.25[2]
Drainage class	reservoir
Number of inlets	0
Number of outlets	1
Flow alteration	spillway, possible beaver dam
Topography	
Minimum watershed elevation (m)	326
Maximum watershed elevation (m)	361
Mean watershed slope (degrees)	3.5
Landcover (% of total watershed)	
Developed, open space and low-intensity (<50% impervious)	7.5
Deciduous forest	56.6
Evergreen forest	5.9
Mixed forest	14.3
Agriculture (hay, cultivated)	2.2
Wetlands	2.6
Mean Impervious surface (% of total watershed)	0.2
Bedrock Geology	
Lower Paleozoic granitic rocks	

Table MA752L.2. Long-term chemistry for Wickett Pond, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.34	0.23	12
ClpH	pH units	5.24	0.17	12
ANC	µeq • L^{-1}	-0.4	5.7	12
DOC	mg • L^{-1}	4.83	1.06	12
Cond	µS • cm^{-1}	17.5	2.1	12
Color*	Pt-Co units	12|20	8|10	6|6
Ca^{2+}	µeq • L^{-1}	46.2	6.0	12
Mg^{2+}	µeq • L^{-1}	16.3	2.0	12
K^+	µeq • L^{-1}	4.7	3.1	12
Na^+	µeq • L^{-1}	54.2	6.0	12
Al (Total)	µg • L^{-1}	95.9	54.0	12
SO_4^{2-}	µeq • L^{-1}	86.5	14.5	12
NO_3^-	µeq • L^{-1}	<1.0	<1.0	12
Cl^-	µeq • L^{-1}	22.2	4.3	12
SiO_2	mg • L^{-1}	0.68	0.55	10
Total P	µg • L^{-1}	10.8	6.5	5
Total N	µg • L^{-1}	308	107	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- The area was settled (ca. 1754)[2], may have burned (ca. 1900)[1], has a concrete spillway built at the outlet[2], and has recently been logged (ca. 2010).
- In 1994, the EPA EMAP sampling team noted that local residents reported a beaver dam having been constructed recently, and a rise in water level following dam construction.
- Within the last 10 years, a few houses have been built nearby, with associated roads and power lines.
- Chloride concentrations (~20 µeq/L) suggest that there is no issue with road salt for this pond.[7] Roads to the pond are paved and navigable with a 2WD vehicle.

Sampling history and other studies at this lake

Wickett Pond was cored in 1994 as part of the EMAP sediment survey. Based on the EMAP core at Wickett Pond, diatom-inferred pH was 6.27 in the bottom section (pre-1850), and 5.0 in the top (recent) section.

Wickett Pond was also cored in 1994 as part of a study related to watershed disturbance history in MA and NH (Fig. MA752L.3).[2] The study evaluated pollen, fossil chironomids, organic matter, and sedimentation rates to compare response to forest clearing and agriculture at the time of settlement (after 1754 near Wickett Pond) and subsequent re-forestation. Reconstructions showed changes that were more minimal than for lakes where disturbance continues and watersheds are not as completely re-forested; however, Wickett Pond displayed an increase in productivity (possibly due to increased sedimentation rates) in the post-settlement era.[2] Despite cessation of the forest clearing disturbance, the ponds have not returned to their pre-disturbance species composition and may be on a new trajectory.[2] The authors also investigated historic maps and soil cores and identified clearing, plowing, and a few dwellings within Wickett's watershed during the 19th century.[2]

During the 1994 research Chl-a was 0.65 μg/L; pH was 5.6; alkalinity was 0.02 μeq/L, and the pond was oligotrophic.[2] Wickett Pond was sampled twice in 1984-5 as part of Massachusetts' Acid Rain Monitoring (ARM) program.[8] In October 1984. pH was 5.1 and SO_4 was 112 μeq/L; in April 1985, pH was 4.5.

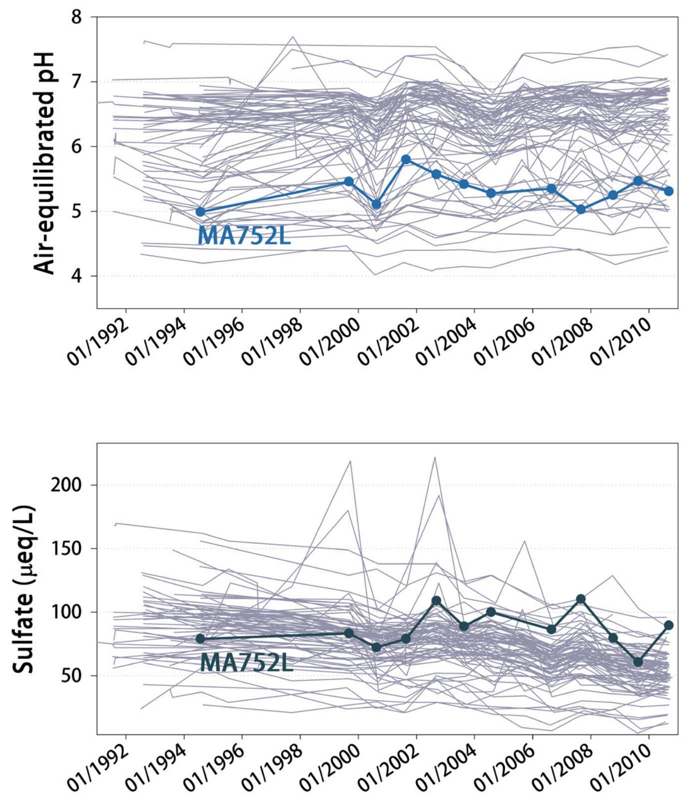


Figure MA752L.4. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Wickett Pond (thick blue line) has had relatively low pH and has low ANC compared to other TIME lakes. Sulfate concentrations have not declined, but have become more variable since 2001.

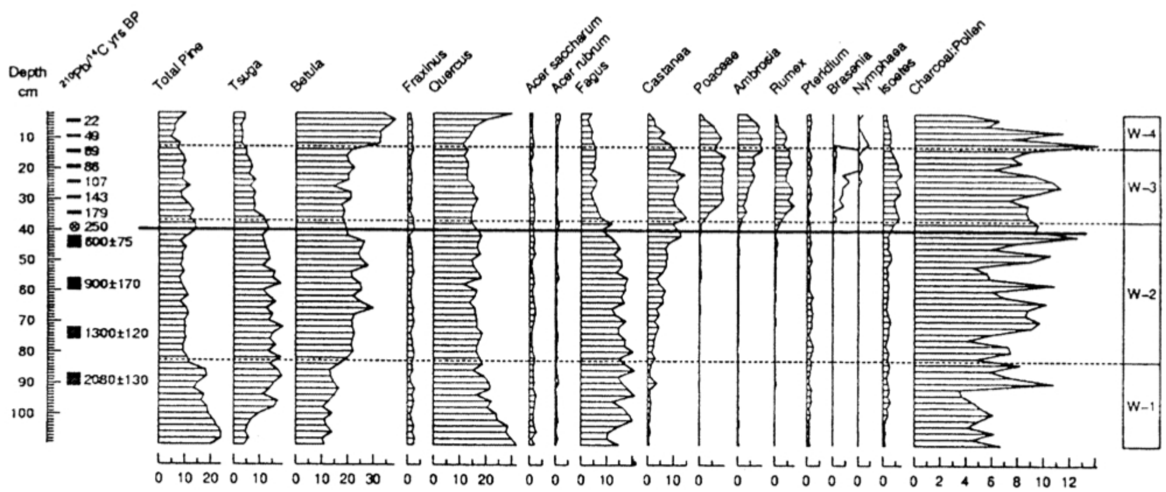


Figure MA752L.3. Pollen-percentage profiles at WIckett Pond, most common taxa. Profiles with open silhouette are 10X exaggeration for display. Settlement horizon at 250 years before present (BP) are marked with a solid line. Analyst: N. Drake.[2]

Photo date: August 2012 • Credit: A. Baumann

References

[1] Massachusetts DCR, 2013.

[2] Francis, D.R., D.R. Foster, 2001.

[3] Massachusetts Department of Conservation and Recreation, 2012

[4] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.

[5] US EPA, 2012.

[6] Nelson *et al.*, 2011.

[7] Rosfjord *et al.*, 2007.

[8] Massachusetts Acid Rain Monitoring (ARM) Program, 2013.

Site access

From I-495

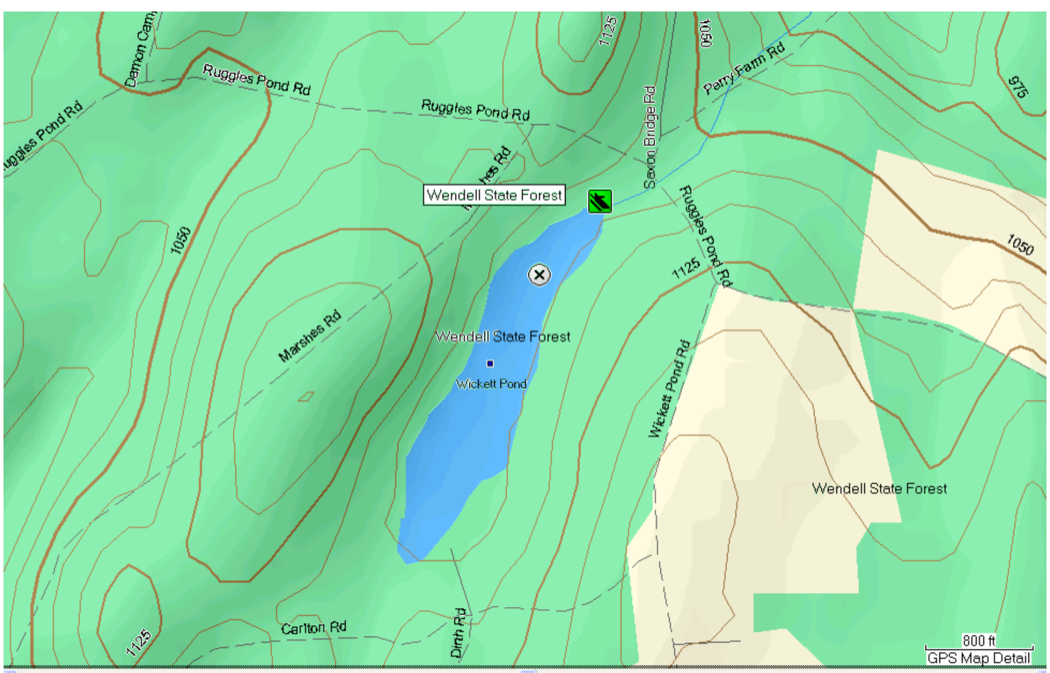
1 hour 12 min, 55.7 mi

Head southwest on Exit 29B toward MA-2 W - **0.4 mi**
Merge onto MA-2 W - **47.8 mi**
Turn left at Nursery Rd - **302 ft**
Turn left at Massachusetts 2A E/W Orange Rd - **0.6 mi**
Take 1st right onto Moss Brook Rd/Wendell Rd/Wendell Depot Rd - **0.4 mi**
Continue onto Depot Rd/Wendell; Continue to follow Depot Rd - **1.4 mi**
Continue onto Wendell Depot Rd - **0.3 mi**
Continue onto Depot Rd - **1.1 mi**
Continue onto Wendell Depot Rd - **1.4 mi**
Turn right at Montague Rd - **0.5 mi**
Turn right at Wickett Pond Rd - **0.6 mi**
Turn right at Ruggles Pond Rd (enter Wendell State Forest) - **1.2 mi**
Park in gravel parking area on left (Wickett Pond is at the edge of the parking area) - **END**

Photo: C. Schmitt, 2002

Launch Site Description

The launch site is at the edge of the gravel parking lot off Ruggles Pond Rd. Although the bottom of the pond is mucky/silty and there is an abundance of emergent vegetation around the launch site, accessing the pond and rinsing bottles from this launch site should not be a problem. Motor boats are not allowed at Wickett Pond.



Wendell, Massachusetts

Coordinates:

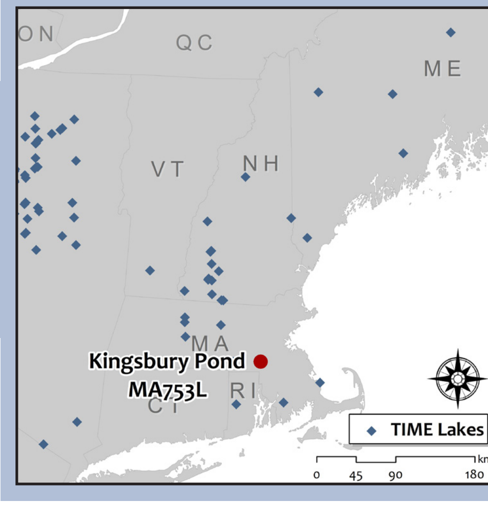
Sampling Point:
N 42.55333
W 72.43011

Launch Point:
N 42.55481
W 72.42844

Kingsbury Pond

Lake ID: MA753L

Other IDs/names: 72056

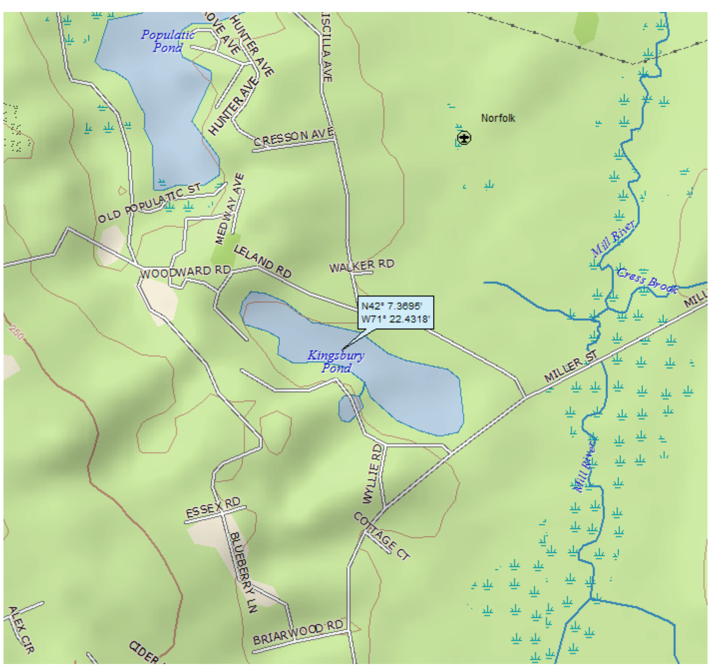


Lake description

Kingsbury Pond, a Massachusetts Great Pond, is located in a heavily populated area with many cottages and homes surrounding the perimeter of the pond. There are no NHESP Core or Critical Habitats identified for Kingsbury Pond or its environs.[1] Kingsbury Pond is within about 50 meters of a wellhead protection area (to the south).[2] There is a potential vernal pool adjacent to the pond, on the southwest.[2] Local roads completely surround the pond, within ~100 meters. Terrain in the watershed is flat, with mostly urban and hardwood landcover.

The 1994 EPA EMAP sampling team reported that on older topographic maps, an island was located in the pond, but that it was not present in 1994. Because of the narrow bottle neck in the middle of the pond it seems much smaller than it actually is.

There was evidence of a pond association (a posted sign) at the 1994 EPA EMAP sampling, and recent activity (anecdotes about swimming in the pond) on an Internet page for the Pond, but no other information about local use or monitoring were found.



Biota

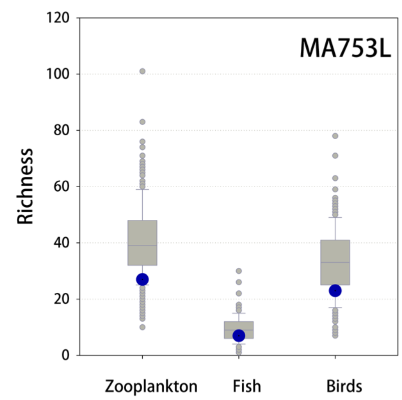
Zooplankton: As part of EMAP, zooplankton were sampled in 1994. Zooplankton species richness in Kingsbury Pond was low (27 species) compared to all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Gomphidae* and *Libellulidae* were collected.

Fisheries: Seven fish species were listed in EMAP data tables; fish species richness was near the lower 25th percentile among EMAP lakes.[3]

Birds: Breeding birds species richness (23 species) was also low compared to other EMAP lakes.[3]

Figure MA753L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).



Bathymetry

No bathymetric map is available for Kingsbury Pond. Depth at the sampling site was 10 m in 2012. Secchi depth averaged 5.0 m in 2004, measured by the TIME sampling crew.

Kingsbury Pond in 2003. Photo: Mitchell Center.

Table MA753L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	7.8
Watershed area (ha)	78.3
Mean depth (m)	4.18[3]
Max depth (m)	no data
Drainage class	seepage
Number of inlets	0
Number of outlets	0
Flow alteration	urbanization
Topography	
Minimum watershed elevation (m)	39
Maximum watershed elevation (m)	95
Mean watershed slope (degrees)	4.8
Landcover (% of total watershed)	
Open water	6.7
Developed, open space and low-intensity (<50% impervious)	35.6
Developed, medium to high density (≥50% impervious)	0.6
Deciduous forest	48.9
Evergreen forest	3.3
Mixed forest	2.3
Agriculture (hay, cultivated)	1.1
Wetlands	1.0
Mean Impervious surface (% of total watershed)	7.3
Bedrock Geology	
Granitic rocks	

Table MA753L.2. Long-term chemistry for Kingsbury, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.78	0.21	12
ClpH	pH units	6.55	0.29	12
ANC	$\mu eq \cdot L^{-1}$	56.9	15.7	12
DOC	$mg \cdot L^{-1}$	3.66	0.48	12
Cond	$\mu S \cdot cm^{-1}$	71.2	10.5	12
Color*	Pt-Co units	5|17	2|8	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	124.0	9.9	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	61.3	7.8	12
K^+	$\mu eq \cdot L^{-1}$	26.1	4.8	12
Na^+	$\mu eq \cdot L^{-1}$	380.1	88.9	12
Al (Total)	$\mu g \cdot L^{-1}$	6.9	5.1	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	91.3	23.9	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	1.2	12
Cl^-	$\mu eq \cdot L^{-1}$	426.4	87.1	12
SiO_2	$mg \cdot L^{-1}$	0.15	0.07	10
Total P	$\mu g \cdot L^{-1}$	10.1	2.2	5
Total N	$\mu g \cdot L^{-1}$	329	69	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Proximity and density of roads and heavy development are likely the main stressor for Kingsbury Pond.
- Using a distance to the coast of 34 km and a formula for background Cl for lakes located within 100 km of the coast,[5] background Cl would be ~70 µeq/L for Kingsbury Pond. The mean Cl concentration for Kingsbury is 426 µeq/L (Table MA753L.2), six times the calculated background, indicating significant road salt inputs at this lake.

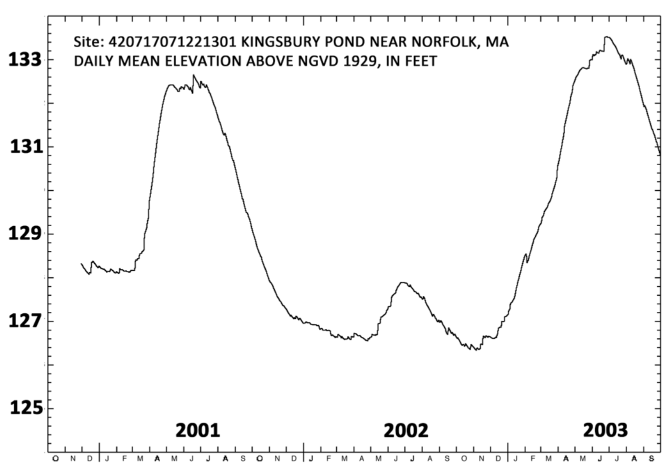
Sampling history and other studies at this lake

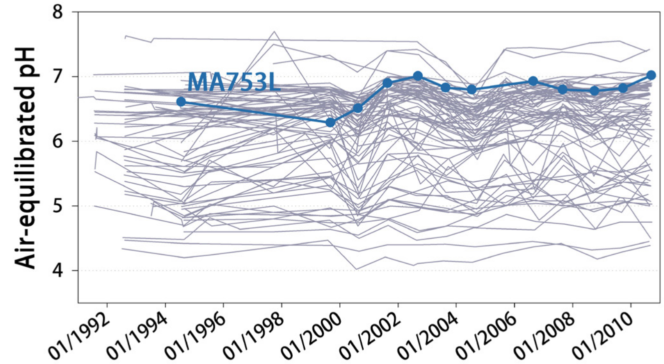
Kingsbury Pond was cored in 1994 as part of an EMAP sediment survey that evaluated top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Kingsbury Pond, diatom-inferred pH was 7.21 in the bottom (pre-1850) section, and 6.58 in the top (recent) section.[3]

The US Geological Survey gaged and monitored water levels in Kingsbury Pond from December 2000 - October 2007, but several periods with missing data were not estimated.[6,7] Pond levels tended to peak in late spring through mid-summer in the three years for which data are available (Fig. MA753L.2); in 2001–2002, the region experienced a severe drought that could account for the low lake levels seen at the gage that year.

Kingsbury Pond was sampled seven times from March-November 1983 as part of Massachusetts' Acid Rain Monitoring (ARM) program.[8] Samples are collected by citizen volunteers. Mean pH in 1983 samples was 5.9; an uncharacteristically low pH in August 1983 may be suspect.[8] Sulfate was only measured in that August sample.

Figure MA753L.2. US Geological Survey lake stage data for Kingsbury Pond, USGS Site ID 420717071221301.[6] Labels have been modified from the original figure to enhance readability.





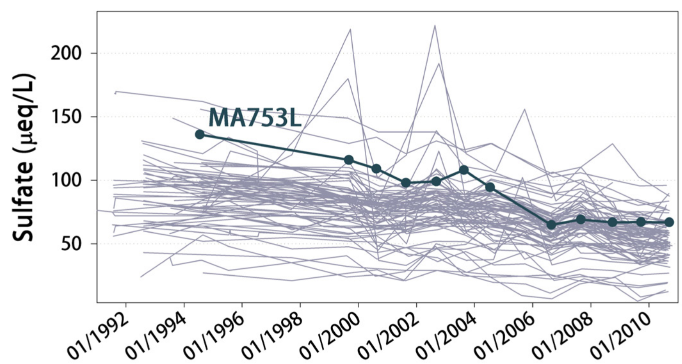
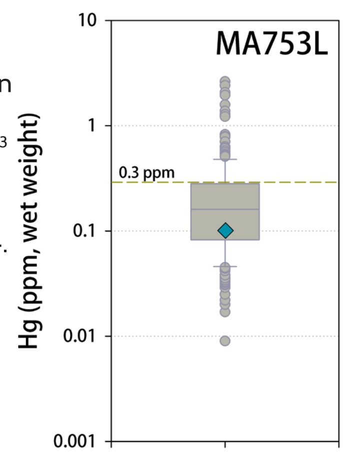


Figure MA753L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Kingsbury Pond (thick blue line) has had among the highest pH (~7) in the TIME dataset. Sulfate in Kingsbury has declined steadily, from 136 µeq/L (1994) to 67 µeq/L (2010), a 50% reduction.

Figure MA753L.4. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot). Kingsbury Pond was sampled in 1994. Its yellow perch (*Perca flavescens*) sample value was 0.1 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.



References

[1] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.

[2] MassDEP, 2013.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] Rosfjord *et al.* 2007.

[6] Socolow *et al.*, 2003.

[7] Comeau, Linda Y. 2013. US Geological Survey - New England Water Science Center. Pers. comm.

[8] Massachusetts Acid Rain Monitoring (ARM) Program, 2013.

Site access

From Interstate 495 — 15 min, 5.3 mi

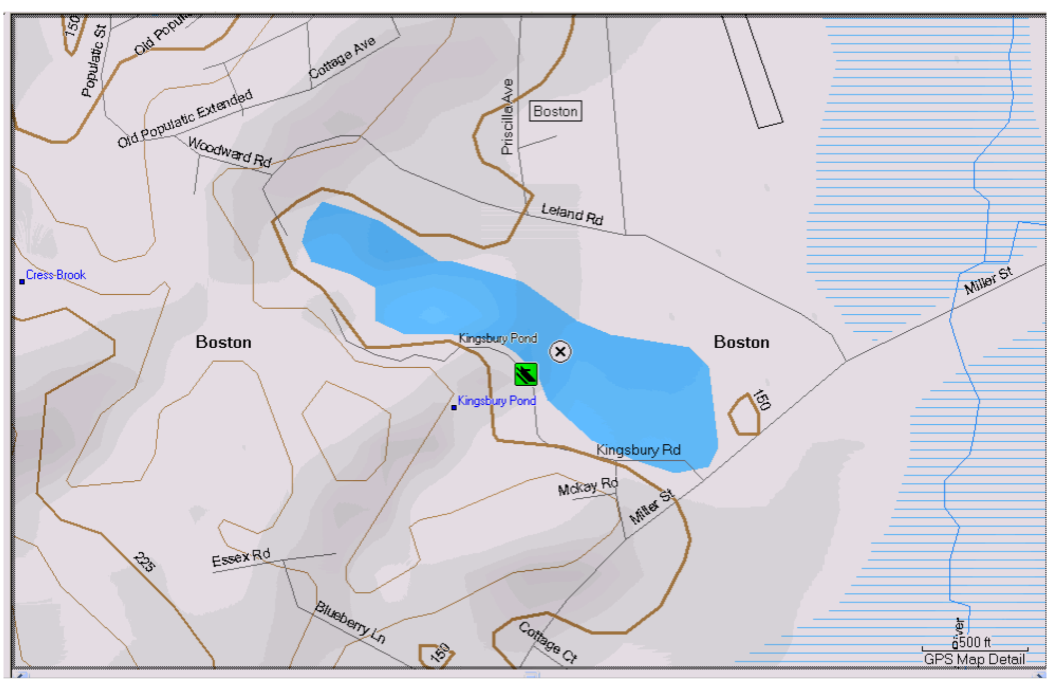
Take exit 17 for MA-140 S toward Franklin - **0.4 mi**
Turn left at W Central St - **0.9 mi**
Slight left at Beaver St - **0.6 mi**
Continue onto Pleasant St - **1.5 mi**
Slight left at Miller St - **0.7 mi**
Sharp left to stay on Miller St - **0.9 mi**
Turn left at Kingsbury Rd - **0.3 mi**
Access to Kingsbury Pond will be on the right at the Kingsbury Pond public beach - **END**
There are “No Parking” signs at the launch area, therefore park somewhere on the side of Kingsbury Rd or Miller Rd and walk to the access point.

Launch Site Description

Where you access the launch from Kingsbury Rd there are several “No Parking” signs. From Kingsbury Rd. down to the launch is a steep slope with many roots. At the bottom of the slope is a flat and sandy launch that allows for easy access to the pond and a suitable rinse area. This is the Kingsbury Pond public beach.

Pond in 2003

Launch in 2002



Norfolk, Massachusetts

Coordinates:

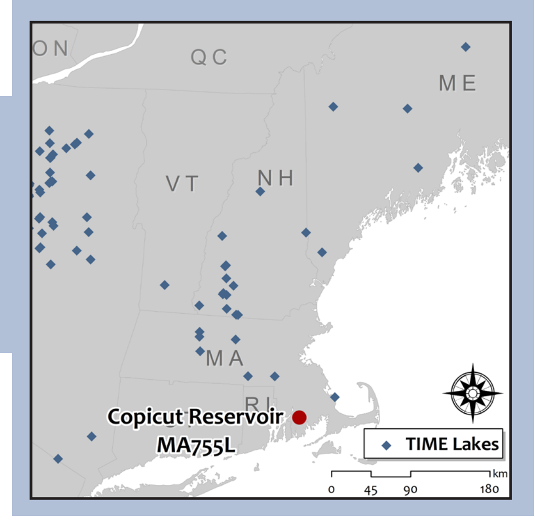
Sampling Point:
N 42.12222
W 71.37261

Launch Point:
N 42.12192
W 71.37321

Copicut Reservoir

Lake ID: MA755L

Other IDs/names: none known

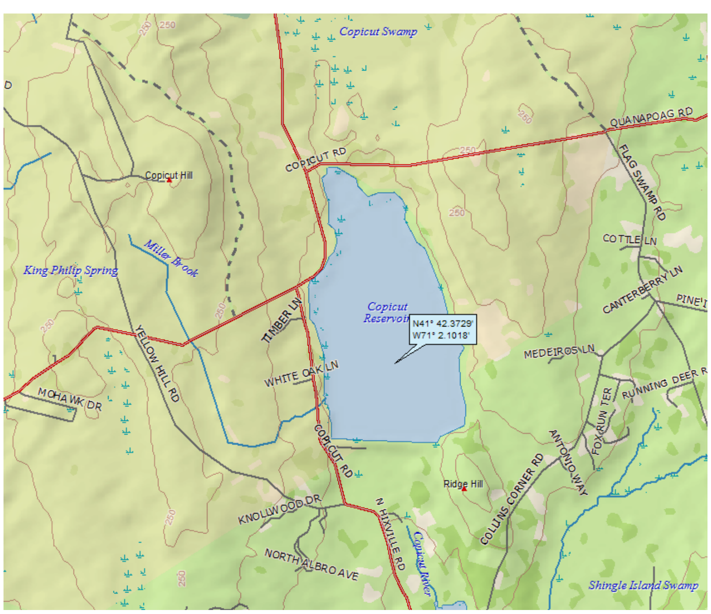


Lake description

Owned by the city of Fall River, Copicut Reservoir is on the Copicut River and is used as a secondary drinking water source for several towns within Bristol County. A community water supply intake is located at the south end of the lake and the lake is surrounded by Surface Water Protection areas and protected open space.[1] Despite the industrial and densely populated nature of this area of Massachusetts, the Reservoir is surrounded by several potected lands including Freetown Fall River State Forest, the Acushnet Wildlife Management Area and State Reservation area, and the Southeast Massachusetts BioReserve (Fig. MA755L.3).

Construction of the reservoir was completed in 1972. In 2009, the reservoir was opened to fishing along the shoreline. However, any other use, including boating and swimming, is prohibited. The dam on the Copicut River (NATID MA02411), is listed as a high hazard dam.[2]

Copicut Reservoir is surrounded by BioMap Core Habitat (ID: 550), a 12,771-acre Core Habitat featuring Forest Core, Wetland Core, Aquatic Core, Vernal Pool Core, five Priority Natural Communities, and 12 Species of Conservation Concern, including 3 threatened and 1 endangered species.[3] Critical Natural Landscape (ID: 361) also surrounds and includes the lake, and is a a large Aquatic Core Buffer, Wetland Core Buffer and Landscape Block.[3]



Biota

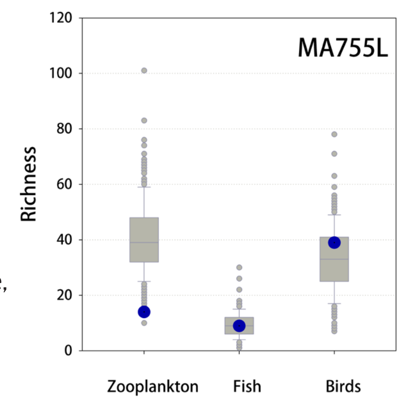
Zooplankton: As part of EMAP, zooplankton were sampled in 1994. Zooplankton species richness in Copicut Reservoir Pond was low (the third lowest) compared to all EMAP lakes.[4]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Aeshnidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: Fish species richness (9 species) was the median value for the EMAP lakes sampled.[4]

Birds: Breeding bird richness (39 species) was high, near the 75th percentile, compared to other EMAP lakes.[4]

Figure MA755L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake, Round Pond (blue dots).



Bathymetry

No bathymetric map is available. However, depth at the 2012 sampling site was 8 m.

Figure MA755L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake (blue dot). Copicut Reservoir was sampled in 1994. Its chain pickerel (*Esox niger*) sample value was 2.1 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.

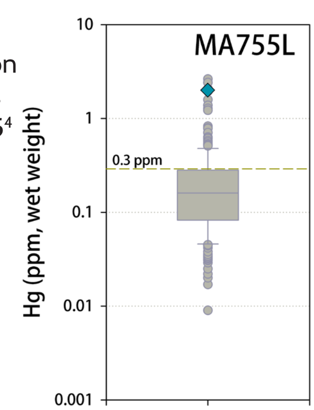


Table MA755L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	214.3
Watershed area (ha)	1706.0
Mean depth (m)	4.59[4]
Max depth (m)	>8
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	human-made pond, dammed
Topography	
Minimum watershed elevation (m)	33
Maximum watershed elevation (m)	108
Mean watershed slope (degrees)	1.5
Landcover (% of total watershed)	
Open water	14.9
Developed, open space and low-intensity (<50% impervious)	2.1
Deciduous forest	44.0
Evergreen forest	8.6
Mixed forest	11.7
Shrub & Herbaceous	0.3
Agriculture (hay, cultivated)	0.6
Wetlands	18
Mean Impervious surface (% of total watershed)	0.1
Bedrock Geology	
Granitic rocks	

Table MA755L.2. Long-term chemistry for Copicut, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.35	0.26	12
ClpH	pH units	5.33	0.24	12
ANC	$\mu eq \cdot L^{-1}$	-0.4	6.4	12
DOC	$mg \cdot L^{-1}$	3.43	0.75	12
Cond	$\mu S \cdot cm^{-1}$	36.7	3.7	12
Color*	Pt-Co units	16|40	12|13	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	59.8	7.3	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	47.7	4.7	12
K^{+}	$\mu eq \cdot L^{-1}$	10.6	0.9	12
Na^{+}	$\mu eq \cdot L^{-1}$	155.1	13.9	12
Al (Total)	$\mu g \cdot L^{-1}$	102.0	32.6	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	121.5	17.9	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	146.2	13.1	12
SiO_2	$mg \cdot L^{-1}$	2.48	0.66	10
Total P	$\mu g \cdot L^{-1}$	10.7	6.2	5
Total N	$\mu g \cdot L^{-1}$	183	66	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Make sure to notify the Fall River Water Commission before sampling.
- Be prepared to talk with concerned or curious locals.
- The 1994 EPA sampling team noted that there are ‘hazards’ near the perimeter/shoreline, probably meaning submerged boulders mentioned earlier in their description.

Sampling history and other studies at this lake

Copicut Reservoir was not cored in the 1991-1995 EMAP sediment survey; sampling was attempted but failed in 1994.

Copicut Reservoir was not assessed for the Massachusetts Integrated List of Waters. The outlet from Copicut Reservoir to Cornell Pond (ID MA95-43) is listed as impaired due to metals other than mercury and toxic organics (1998–2006 lists) and PCBs and mercury in fish tissue (2010 list).[6] The mercury impairment is consistent with the high mercury concentration in 1994 EMAP fish sampling (Fig. MA755L.2).

Figure MA755L.3. The Southeast Massachusetts BioReserve includes lands bordering Copicut Reservoir. Map of land ownership and use, 2009. Source: Massachusetts Division of Fish and Wildlife, Wildlife Management Area Maps.[7]

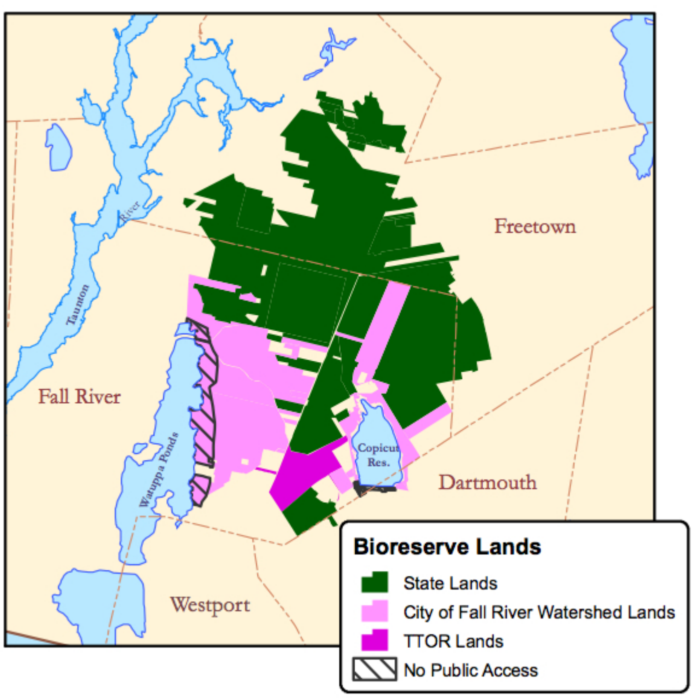
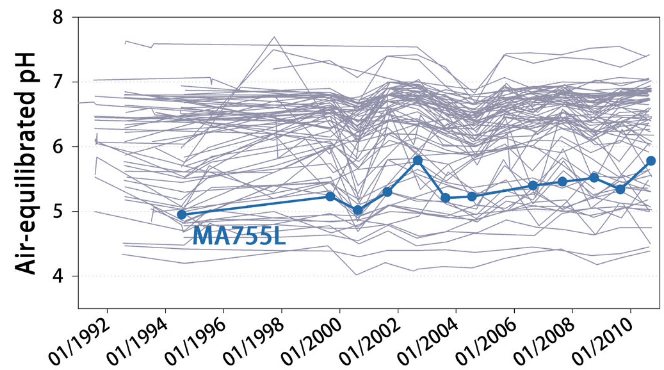



Photo date: August 2012 • Credit: A. Baumann



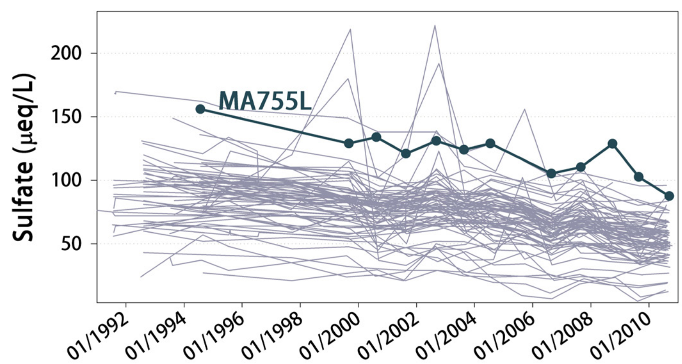


Figure MA755L.4. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Copicut Reservoir (thick blue line) has had among the lowest pH and highest sulfate measurements in the TIME dataset. Sulfate declined 43% by 2010, compared to the 1994 concentration.


Copicut Reservoir, 2003.
Photo: C. Schmitt

References

[1] MassDEP, 2013.

[2] Massachusetts DCR, 2012.

[3] MA Department of Fish & Game, DFW, NHESP, and TNC, 2010.

[4] US EPA, 2012.

[5] Nelson *et al.*, 2011.

[6] US EPA, 2013.

[7] MA Division of Fish and Wildlife, Wildlife Area Management Maps, available: http://www.mass.gov/dfwele/dfw/habitat/maps/wma/wma_maps.htm

Site access

From Interstate-195

10 min, 4.8 mi

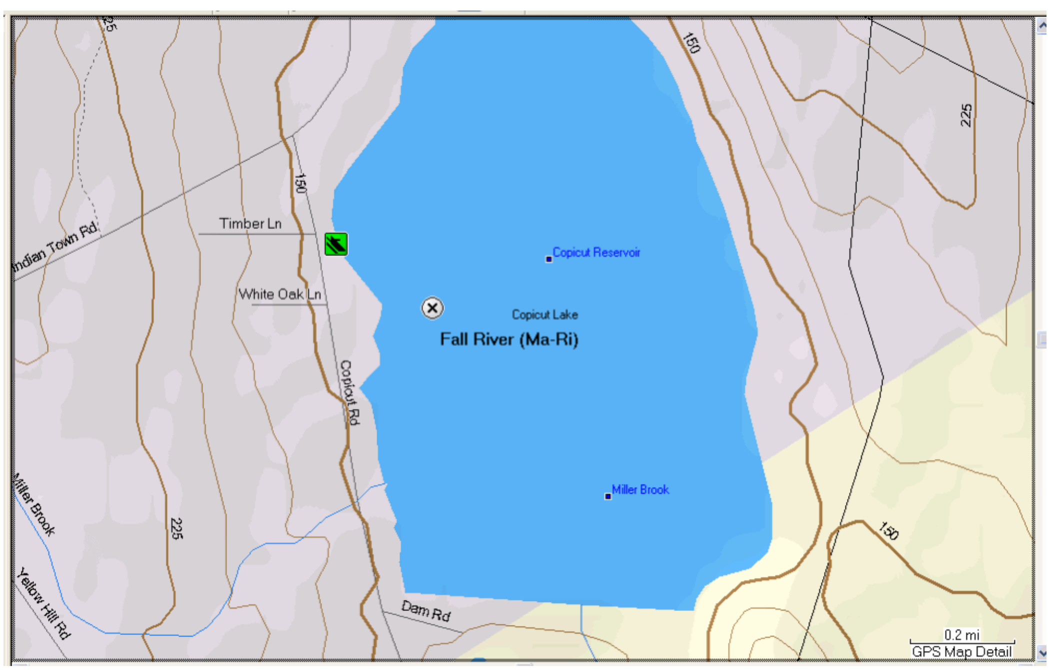
Head southeast on Exit 11 toward Reed Rd - **0.2 mi**
Turn left at Reed Rd - **2.0 mi**
Continue straight onto Old Fall River Rd - **128 ft**
Continue onto N Hixville Rd - **1.1 mi**
Turn right at Copicut Rd - **1.1 mi**
Park in gravel parking area - **END**

Launch Site Description

From the gravel parking area there is a short path (approximately 30') through the forested buffer to a suitable launch site. The launch site has a slight slope with a gravel/rocky bottom.

Launch area, 2003

Near launch area, 2002



Fall River, Massachusetts

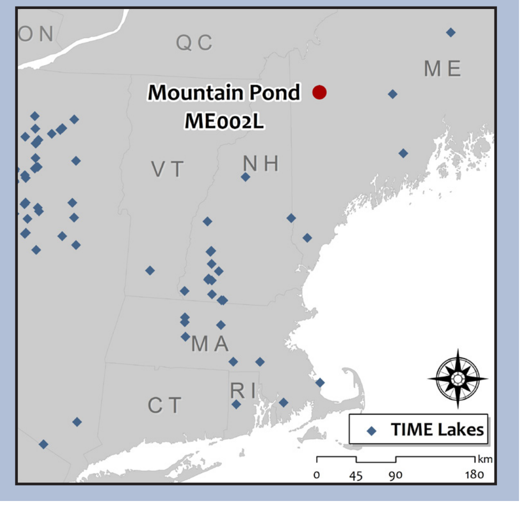
Coordinates:
Sampling Point:
N 41.70813
W 71.04043

Launch Point:
N N41.70989
W 71.04403

Mountain Pond

Lake ID: ME002L

Other IDs: MIDAS: 3540; HELM MTN-R; GNIS: 571809

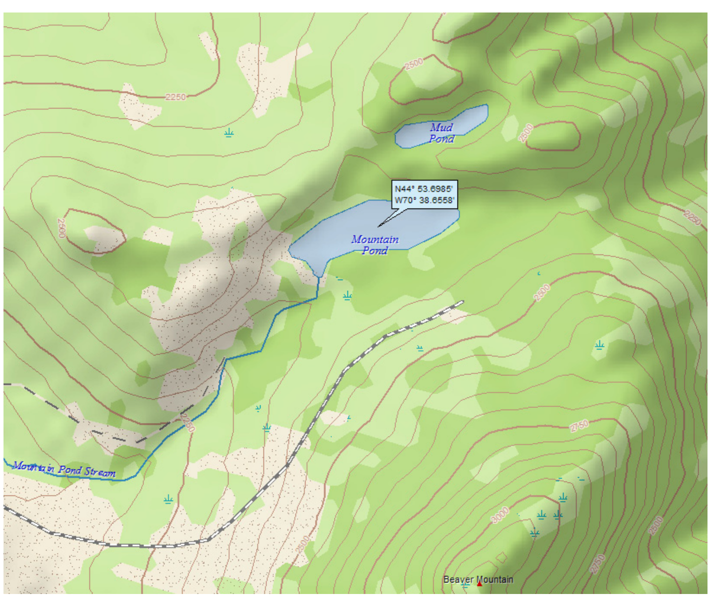


Lake description

Mountain Pond in Rangeley Plantation is a high elevation lake (~2,400 ft) on Beaver Mountain (summit: 3,133 ft/955 m) located ~3 miles north of the Appalachian Trail. In the midst of the Rangeley Lakes region, it is 2 miles south of Rangeley Lake, and 3 miles east of Mooselookmeguntic Lake, two very large lakes in the region. It is fed by Mud Pond, a smaller pond, via a short (<200 m) section of Mountain Pond Stream.

In the Maine Wildlands Lake Assessment, Mountain Pond was rated "Outstanding" with respect to fisheries. Other wildlife attributes were not rated. Its resource class was 1B, a lake of statewide significance with one outstanding value.[1] The pond is listed as mesotrophic with a flushing rate of 1.27 times per year. Although small, Mountain Pond is relatively deep (max depth=11 m).[2] Mountain Pond is somewhat elongate with a shoreline development index 1.46.[2]

The immediate watershed area is very dense conifer forest. Other areas lower in the watershed have been harvested. In the 1991 sampling, the trail was not as well-maintained and logging operations may have been more recent. The EPA crew wrote that "this trail is the largest slice of hell I have ever had. It is very steep, many ankle busters. Trees are blown down...trail disappears in a clearcut you have to navigate through for over ¼ mile". The trail is now well-marked and used by hikers often.



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1991 and 1995. Zooplankton species richness in Mountain Pond was moderately low, just above the 25th percentile for all EMAP lakes.[3]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in September 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected.
Fisheries: The pond is a coldwater fishery, with only wild brook trout (*Salvelinus fontinalis*) listed in Maine data sources; however it is listed as an outstanding fishery.[1,5] No fish data were listed in EMAP data tables.[3]
Birds: Breeding birds were not listed in EMAP data tables.[3]

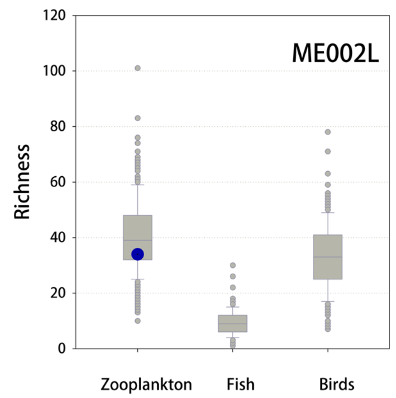


Figure ME002L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this pond (blue dots).

Bathymetry

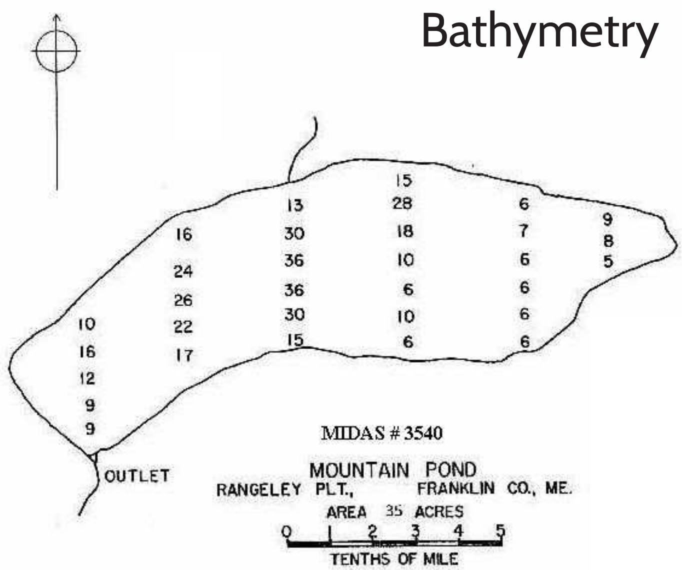


Table ME002L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	11.1
Watershed area (ha)	132.0
Mean depth (m)	3.96[2]
Max depth (m)	11[2]
Drainage class	drainage
Number of inlets	1
Number of outlets	1
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	722
Maximum watershed elevation (m)	931
Mean watershed slope (degrees)	6.3
Landcover (% of total watershed)	
Open water	9.5
Deciduous forest	1.0
Evergreen forest	68.7
Mixed forest	13.0
Shrub & Herbaceous	7.0
Wetlands	3.8
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Silurian eugeosynclinal	

Table ME002L.2. Long-term chemistry for Mountain Pond, 1986-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.24	0.31	26
ClpH	pH units	5.93	0.24	24
ANC	$\mu eq \cdot L^{-1}$	22.5	7.4	27
DOC	$mg \cdot L^{-1}$	5.06	1.08	25
Cond	$\mu S \cdot cm^{-1}$	14.8	2.1	27
Color*	Pt-Co units	22|30	12|13	19|8
Ca^{2+}	$\mu eq \cdot L^{-1}$	60.6	7.7	27
Mg^{2+}	$\mu eq \cdot L^{-1}$	27.6	3.6	27
K^+	$\mu eq \cdot L^{-1}$	5.0	1.5	27
Na^+	$\mu eq \cdot L^{-1}$	28.6	3.0	27
Al (Total)	$\mu g \cdot L^{-1}$	104.6	39.7	26
SO_4^{2-}	$\mu eq \cdot L^{-1}$	65.7	11.3	26
NO_3^-	$\mu eq \cdot L^{-1}$	1.1	2.0	26
Cl^-	$\mu eq \cdot L^{-1}$	9.2	1.9	26
SiO_2	$mg \cdot L^{-1}$	1.80	0.79	20
Total P	$\mu g \cdot L^{-1}$	6.9	2.9	14
Total N	$\mu g \cdot L^{-1}$	246	152	17

* Color is displayed as True|Apparent

Site disturbance & considerations

- The area around Mountain Pond has been logged and remains an active logging area. The bottom of the pond near the launch is lined with many logs, making footing difficult.
- As a high elevation lake, Mountain Pond is especially susceptible to atmospheric deposition.
- The trail to the pond is persistently steep; expect to take longer than a typical 1.5 mile hike.

Sampling history and other studies at this lake

Mountain Pond was cored in 1991 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Mountain Pond, diatom-inferred pH was 6.37 in the bottom section (pre-1850), and 5.84 in the top (recent) section.[3]

Mountain Pond is one of the longest continuously sampled in the Maine database. HELM sampling began in 1986 and the lake continues as both a TIME and HELM lake. It has been sampled in fall via helicopter in several of the project years, due to its remote location and difficulty of access. Secchi disk depth was 3.7 m in late summers of 1991 and 1995. Chlorophyll-a was low in 1991 and 1995 (0.6–3.2 µg/L). Sulfate has declined (83 µeq/L in 1986 to 48 µeq/L in 2010), but aluminum and DOC have been steadily increasing as conductivity has declined (Fig. ME002L.2).

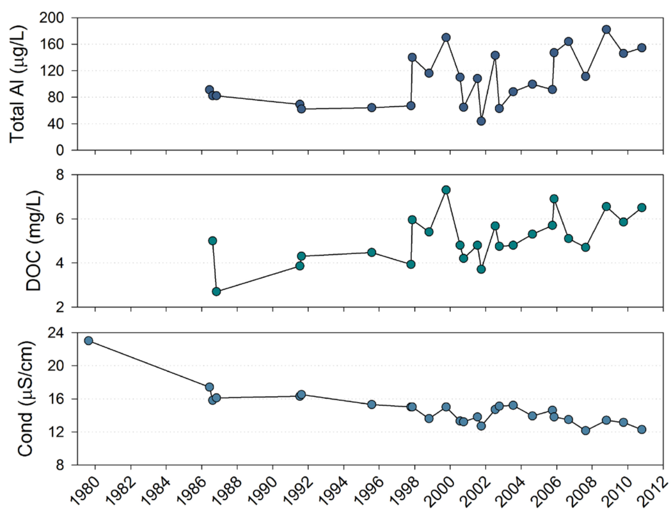


Figure ME002L.2. 1978-2010 time series data for total aluminum (Al), dissolved organic carbon (DOC), and conductivity (Cond) in Mountain Pond. Data prior to 1991 were from HELM or other University of Maine sampling.

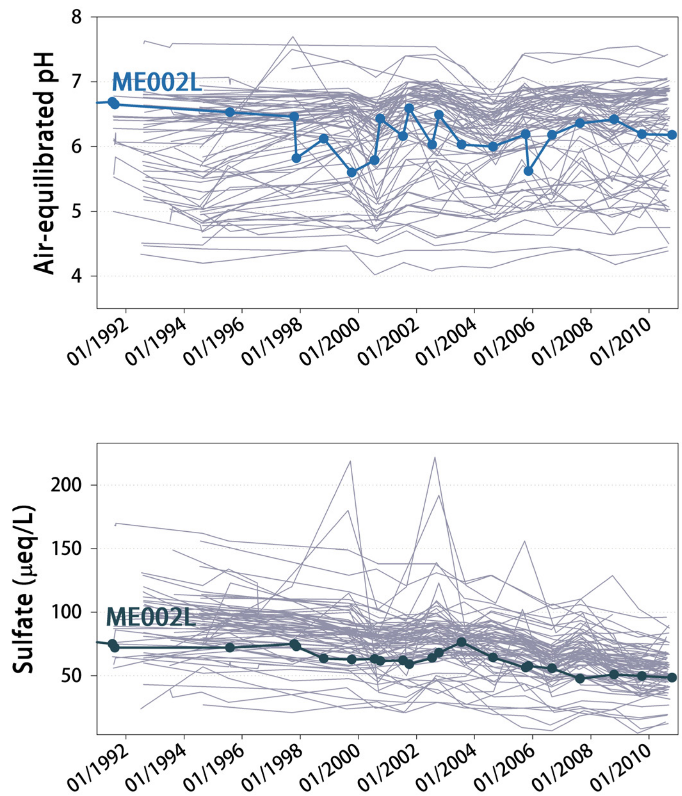


Figure ME002L.3. 1991-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Mountain Pond (thick blue line) has had moderately low pH and sulfate among lakes in the TIME dataset. Sulfate has declined during the period of record.

Mountain Pond from the air, during HELM helicopter sampling. Photo: Mitchell Center staff.

References

[1] Maine Department of Conservation, 1987.

[2] Vaux and Entwood, 2010.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] Dembeck, 2009.

Site access

From Bangor, Maine 2.5 hours, 124 mi

Take I95 S - **50.8 mi**
Take exit 132 for ME139 toward Fairfield/Benton **- 0.3 mi**
Keep right at the fork, follow signs for Maine 139 **- 118 ft**
Turn right onto ME139 W/Center Rd **- 1.9 mi**
Turn right onto ME104 N/ME139 W/Norridgewock Rd **- 10.6 mi**
Continue onto US2 W/U.S. 201A N**- 21.7 mi**
Turn right onto Main St **- 0.9 mi**
Slight left onto ME4 N/Fairbanks Rd**- 10.7 mi**
Slight left onto ME4 N/Phillips Rd**- 24.3 mi**
Turn left toward Edelheid Rd **- 151 ft**
Turn left onto Edelheid Rd **- ~1 mi – END**
Park at utility pole #13. Trailhead is on the right, with a footbridge over the culvert.


Parking

Launch Site Description

The trail is well-marked once you find the trailhead, just across the ditch from the road. A small wooden footbridge leads over the ditch and to the marked trailhead. From here, follow red blazes. Twice you will cross large cleared swaths; watch for "trail" arrow signs posted across the cut.


Trailhead

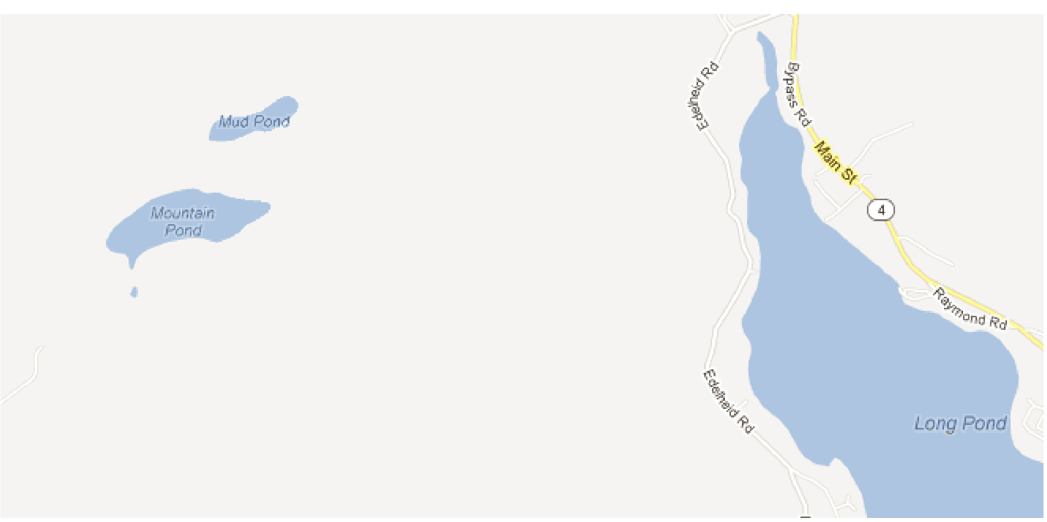
Trailhead


Launch


Example trail marker


One cut swath crossing

Rangeley Plt, Maine



Coordinates:

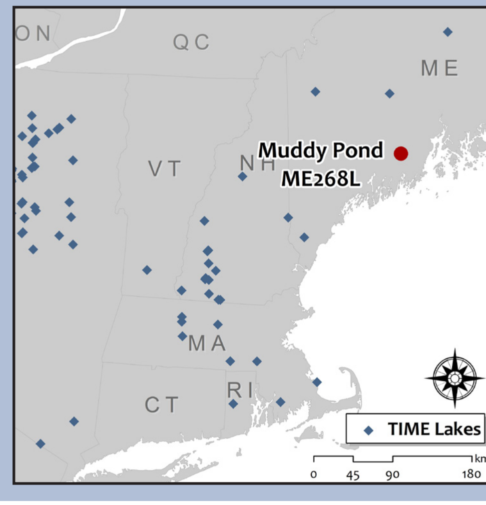
Sampling Point:
N 44.895000
W 70.644203

Launch Point:
N 44.89348
W 70.64715

Parking:
N 44.89792
W 70.61572

Muddy Pond

Lake ID: ME268L
Other IDs/names: Spring Pond; MIDAS: 4892



Lake description

Muddy Pond is located in the town of Washington, in the midcoast Maine region. Most of the lake is quite shallow (mean depth=2.55 m) with emergent vegetation such as white and yellow pond lilies (*Nymphaea, Nuphar*), and pickerel weed (*Pontederia*). The area to the west and south of the pond is sandy; the parking area is at an old sand pit and other sand and gravel pits are visible nearby. Only one visible home or camp is on the pond, at the northwest, with a wood dock built into the pond.

Muddy Pond is very elongate, with shoreline development index of 2.19. The lake volume is estimated at 186,256 m^3, and flushing rate is 1.4 times per year.[1] It is mesotrophic, supporting a warmwater fishery.[2] Despite its wetland-like setting, dissolved organic carbon and color are low. Pond sediments near the shore have a reddish color, perhaps related to known iron-rich geologic materials in the Washington area. There are sandy sediment pockets among the mucky areas.

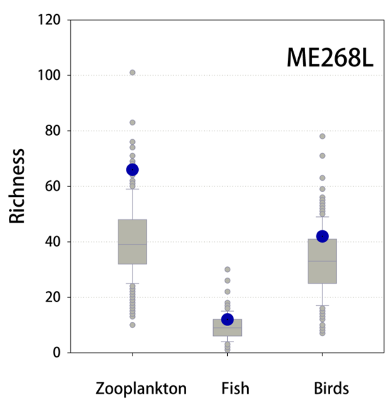


Figure ME268L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and Muddy pond (blue dots).

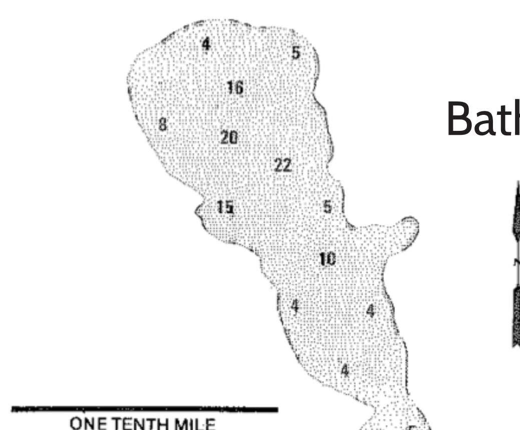
Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992 and 1993. Zooplankton species richness in Muddy Pond was among the highest of all EMAP lakes sampled.[3] Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae* and *Libellulidae* were collected. Many leeches were observed.

Fisheries: Seven species of fish are listed in Muddy Pond, according to Maine Inland Fisheries and Wildlife data.[2] Sampled in 1992 and 1993, fish species richness (12 species) was at the 75th percentile for all EMAP lakes sampled.[3]

Birds: Sampled in 1992 and 1993, breeding bird richness was also high, slightly greater than the 75th percentile as compared to all EMAP lakes.[3]

Bathymetry



Note: Muddy Pond is also known as Spring Pond.

Spring Pond
Washington, Maine Atlas Map 13, C-4
Acres: 15, Max. Depth: 22 feet

Table ME268L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	7.8
Watershed area (ha)	54.6
Mean depth (m)	2.55[3]
Max depth (m)	6.7
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	beaver dam
Topography	
Minimum watershed elevation (m)	82
Maximum watershed elevation (m)	116
Mean watershed slope (degrees)	1.9
Landcover (% of total watershed)	
Open water	10.4
Developed, open space and low-intensity (<50% impervious)	6.9
Developed, medium to high density (≥50% impervious)	0.2
Deciduous forest	4.9
Evergreen forest	26.9
Mixed forest	38.9
Shrub & Herbaceous	4.4
Wetlands	2.7
Mean Impervious surface (% of total watershed)	0.9
Bedrock Geology (% of total watershed)	
• Middle Paleozoic granitic rocks (80%) • Devonian and Silurian eugeosynclinal (20%)	

Table ME268L.2. Long-term chemistry for Muddy Pond, 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	7.46	0.21	12
ClpH	pH units	6.95	0.18	12
ANC	$\mu eq \cdot L^{-1}$	198	10.2	12
DOC	$mg \cdot L^{-1}$	2.80	0.58	12
Cond	$\mu S \cdot cm^{-1}$	36.5	2.4	12
Color*	Pt-Co units	11|14	2|6	7|5
Ca^{2+}	$\mu eq \cdot L^{-1}$	151.6	11.0	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	72.6	3.3	12
K^{+}	$\mu eq \cdot L^{-1}$	15.4	1.4	12
Na^{+}	$\mu eq \cdot L^{-1}$	113.6	7.9	12
Al (Total)	$\mu g \cdot L^{-1}$	5.8	3.6	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	64.5	4.8	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	71.7	9.9	12
SiO_2	$mg \cdot L^{-1}$	5.27	0.95	10
Total P	$\mu g \cdot L^{-1}$	11.6	6.1	5
Total N	$\mu g \cdot L^{-1}$	206	118	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- There is another Muddy Pond in the town of Washington, which is smaller than this pond.
- There is poison ivy at the launch at the south end of the pond.
- Several sand and gravel pits are in the area of the pond.
- There are known iron deposits in some portions of Washington.
- There is a beaver lodge near the southern end of the pond. The outlet runs under Route 105.

Sampling history and other studies at this lake

Muddy Pond was cored once in 1992 and twice in 1993 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Muddy Pond, diatom-inferred pH was 7.8-8.11 in the bottom (pre-1850) sections, and 7.78-7.86 in the top (recent) sections.[3]

Muddy Pond (ME268L) was not sampled in 1999–2001 TIME field seasons because an EMAP lake called Muddy Pond in Massachusetts was sampled instead.

Muddy Pond from the western shore, looking back toward the parking area to the south. Emergent plants cover most of the pond at its southern end.

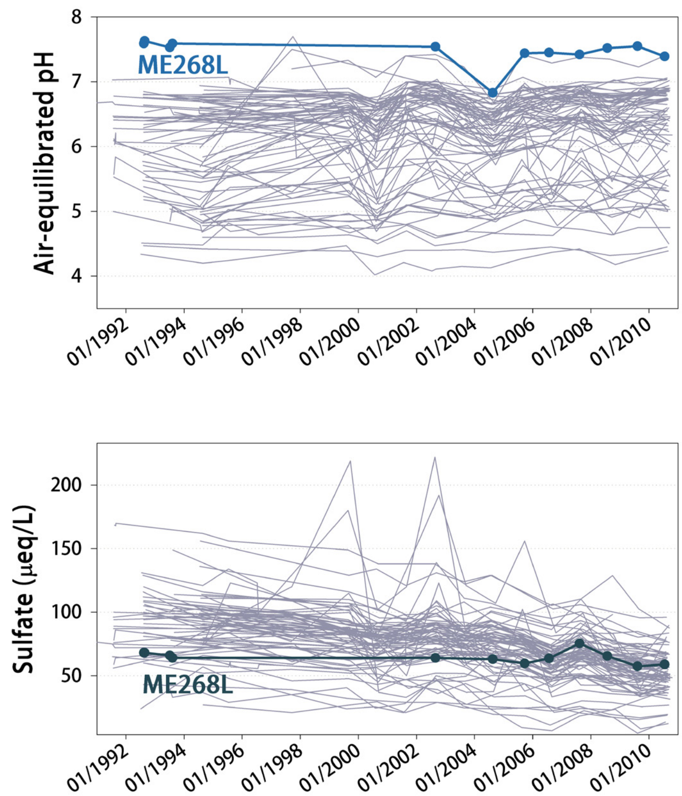


Figure ME268L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Muddy Pond (thick blue line) has had the highest pH and moderate to low sulfate among lakes in the TIME dataset. Sulfate has not declined during the TIME project, but it was among the lowest among TIME lakes in the beginning of the period.

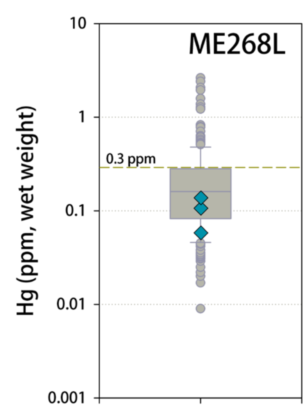


Figure ME268L.3. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot). Muddy Pond was sampled in 1992 and 1993. Its chain pickerel (*Esox niger*) samples averaged 0.121 ppm, and brown bullhead sample value was 0.060 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.

References

[1] Vaux and Entwood, 2010.

[2] Dembeck, 2009.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

Site access

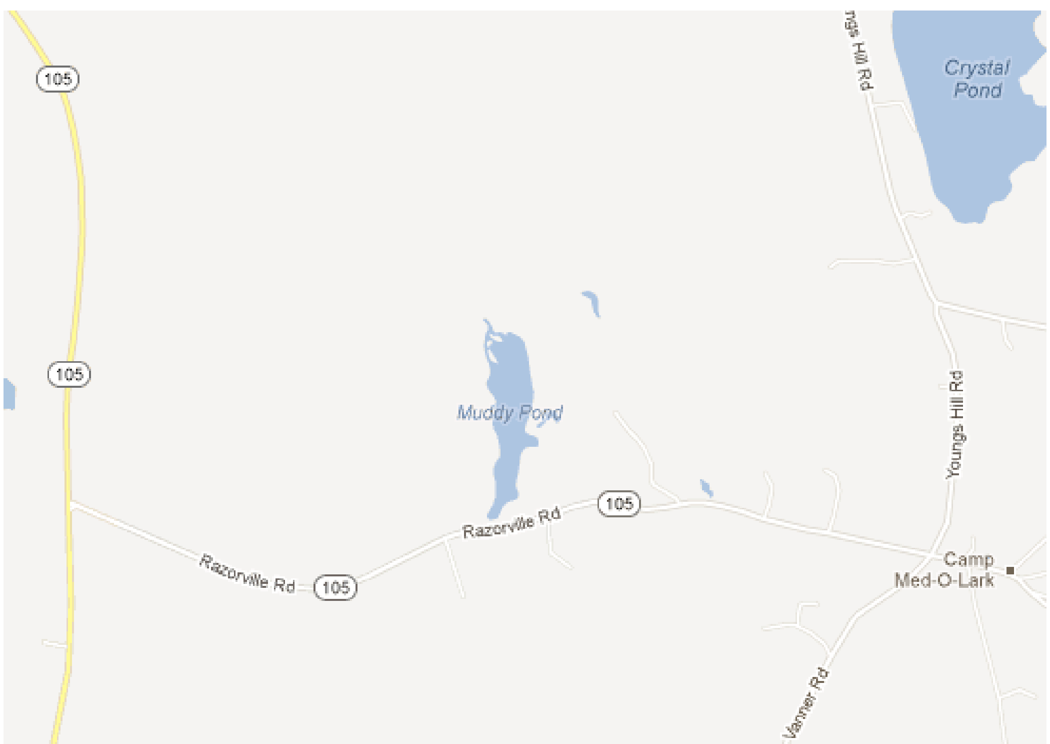
From Bangor, ME 1.5 hr, 65 mi

Take I95 - **9.6 mi**
Take exit 174 for ME69 toward Carmel/Winterport - **0.2 mi**
Sharp left onto ME69 E/Carmel Rd N - **1.8 mi**
Turn right onto ME9 W/US202 W/Western Ave - **20.3 mi**
Turn left onto ME220 S/Thorndike Rd - **9.2 mi**
Turn left to stay on ME220 S - **6.3 mi**
Turn left to stay on ME220 S - **3.3 mi**
Turn left onto ME220 S/W Main St - **1.0 mi**
Turn right to stay on ME220 S/W Main St - **9.3 mi**
Continue onto ME105 W/Razorville Rd **- 2.5 mi - END**
You will pass the pond on your right; park at gravel pit road on right/west side of pond, north of Route 105.

Launch Site Description

You can launch from the parking area, but there is a good amount of poison ivy and you need to paddle most of the length of the pond. There is an easier launch approximately halfway up the western shore of the pond. Walk along the sandy road to reach the launch.

Launch on western shore of pond. Deep hole can be seen toward the north (at left in photo)



Washington, Maine

Coordinates:
Sampling Point:
N 44.28132
W 69.41569

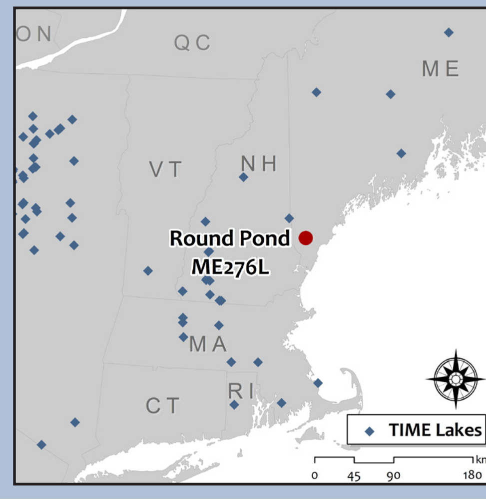
Launch Point:
N 44.27976
W 69.416504

Parking:
N 44.31206
W 69.35258

Round Pond

Lake ID: ME276L

Other IDs/names: MIDAS: 3858



Lake description

Round Pond is located in extreme southern Maine, in the town of Sanford (York County). The pond is surrounded by emergent and floating vegetation, and is small and isolated compared to other TIME lakes. As noted by the original EPA-EMAP field crew, "most locals don't know where Round Pond is. It took us 3+ hours to find it!"

The Sanford Ponds area, including Round Pond, is a focal conservation area identified by Maine's Beginning With Habitat program.[1,2] This 1,300 acre area is one of Maine's largest Atlantic white cedar swamps, a habitat type that is rare in the state. The area is home to several rare reptiles and plants as well as several vernal pools.[1]

There are abundant white cedars, wetland shrubs (leatherleaf), and pitcher plants on the shores of the pond and a high amount of dissolved organic matter in the water gives Round Pond a boggy resemblance. Substrate under the shoreline shrubs is peat. The landscape surrounding the pond is dominated by dense upland conifer forest and includes pitch pine-oak barrens. Despite the boggy setting, the area around the pond is quite sandy, notable on the hike in to the pond. The surrounding area is low-lying and may flood during rain events.

Secchi disk depths were 1.0 m in July 1995 and 1.3 m in July 2003. Chlorophyll-a was 2.4 µg/L in 1995; based on this and total phosphorus data (Table ME276L.1), the pond appears generally oligotrophic.

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992, 1994, and1995. Zooplankton species richness in Round Pond was slightly greater than the median for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae* and *Libellulidae* were collected. Beetles were the only other taxa observed, though sampling was not exhaustive.

Fisheries: There are no known survey data on presence or extirpation, based on Maine data sources.[5] No fish data were listed in EMAP data tables.[3]

Birds: Breeding birds were not listed in EMAP data tables.[3]

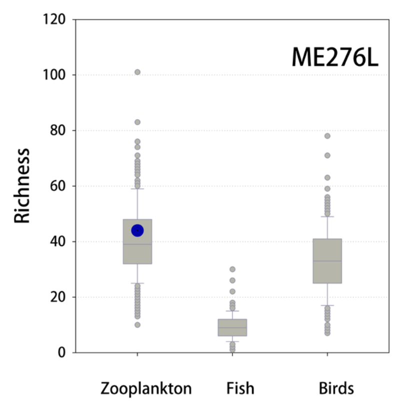


Figure ME276L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, Round Pond (blue dots).

Bathymetry

No bathymetric map is available for Round Pond. However, field data collected in summer 2012 indicate a depth near the center of the pond (at the sampling location) of 5.5 m. The launch site and much of the southern shore of the pond is best characterized as floating bog/shrub vegetation, at least 1.5-2 meters deep immediately along the shore and launch site.

Maine data from the Department of Environmental Protection, Inland Fisheries and Wildlife, and derived from GIS indicate a lake volume of 59,947 m^3 and flushing rate of 1.9 times/year.[6] As its name suggests, Round Pond is very rounded in shape with a shoreline development ratio of 1.07.

Table ME276L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	1.5
Watershed area (ha)	19.5
Mean depth (m)	2.55[3]
Max depth (m)	>5.5
Drainage class	seepage
Number of inlets[3]	0
Number of outlets	0
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	76
Maximum watershed elevation (m)	81
Mean watershed slope (degrees)	0.4
Landcover (% of total watershed)	
Open water	4.1
Deciduous forest	3.2
Evergreen forest	15.2
Mixed forest	28.1
Wetlands	43.2
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Middle Paleozoic granitic rocks	

Table ME276L.2. Long-term chemistry for Round Pond, 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	4.24	0.13	16
ClpH	pH units	4.25	0.15	16
ANC	$\mu eq \cdot L^{-1}$	-65.8	19.6	16
DOC	$mg \cdot L^{-1}$	27.92	7.23	16
Cond	$\mu S \cdot cm^{-1}$	45.3	6.9	16
Color*	Pt-Co units	332|225	86|59	10|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	44.9	10.5	16
Mg^{2+}	$\mu eq \cdot L^{-1}$	30.4	6.3	16
K^{+}	$\mu eq \cdot L^{-1}$	4.7	2.7	16
Na^{+}	$\mu eq \cdot L^{-1}$	115.4	19.3	16
Al (Total)	$\mu g \cdot L^{-1}$	128.6	32.6	16
SO_4^{2-}	$\mu eq \cdot L^{-1}$	27.6	16.3	16
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	16
Cl^{-}	$\mu eq \cdot L^{-1}$	103.3	22.0	16
SiO_2	$mg \cdot L^{-1}$	1.88	1.09	13
Total P	$\mu g \cdot L^{-1}$	10.9	3.9	7
Total N	$\mu g \cdot L^{-1}$	540	91	11

* Color is displayed as True|Apparent

Site disturbance & considerations

- There are ATV trails near and up to the pond.
- There is another "Round Pond" in neighboring Alfred, Maine; it is approximately twice the size of this Pond.
- In 2005, a 12-lot subdivision "Great Works Village" was built southeast of the pond, where previous sampling crews had parked and used a trailhead (off Sand Pond Rd.).
- Sandy Point Road is posted "Private Road".

Sampling history and other studies at this lake

Round Pond was cored in 1992 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core collected at Round Pond, diatom-inferred pH was 6.13 in the bottom (pre-1850) section, and 4.58 in the top (recent) section.[3]

In addition to EMAP and TIME water sampling, one sample of modern water chemistry was taken in July 2001 by Seger,[7] as part of a Maine seepage lake project called ALPS (Aquifer Lakes Project). ALPS sampled the chemistry of Maine lakes on or associated with mapped sand and gravel aquifers. ALPS lakes are seepage lakes, defined as lakes that have no surface inlets. The lake was not visited again, and may have been erroneously sampled, since Round Pond in neighboring Alfred was maintained in the ALPS project (called ROUNA, MIDAS# 3978 in the long-term database).

The 'shoreline' of Round Pond, showing shrub vegetation and darkly-stained water color. Dissolved organic carbon (DOC) in Round Pond has been 27.9±7.2 mg/L (mean±SD).

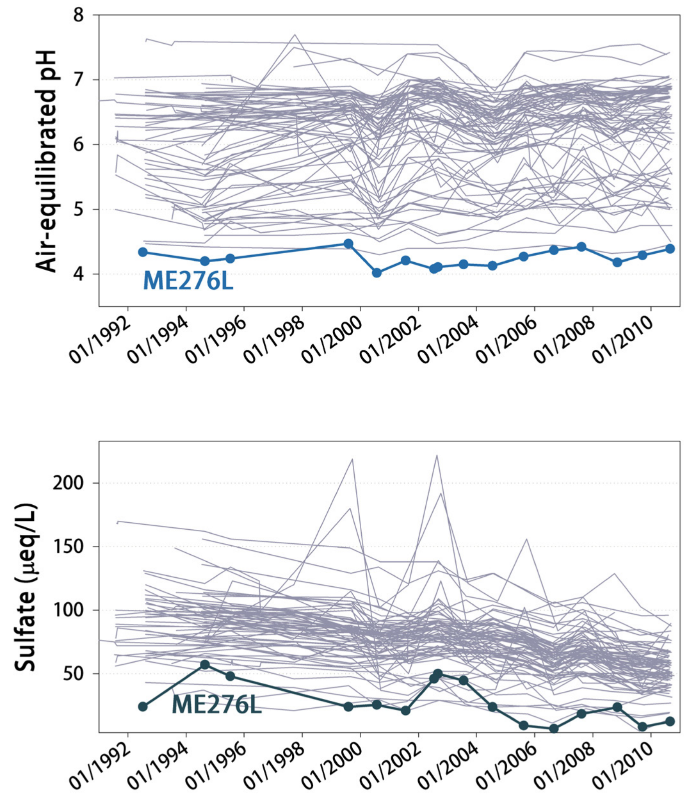


Figure ME276L.2. 1992-2011 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Round Pond, ME276L (thick blue line) has had among the lowest pH and lowest sulfate measurements in the TIME dataset. Because of its bog-like setting, the pond is probably naturally acidic.

References

[1] Beginning With Habitat, 2003.

[2] Wells National Estuarine Research Reserve, 2009.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] Dembeck, 2009.

[6] Vaux and Entwood, 2010.

[7] Seger, 2004.

Sundew at Round Pond.
Photo: Jen McKay, 2012

Photo date: August 9, 2012 • Credit: S. Nelson

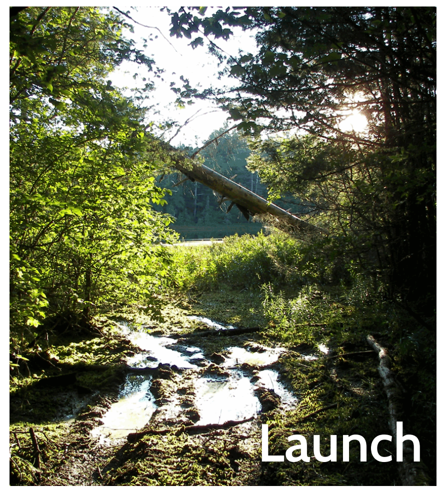
Site access

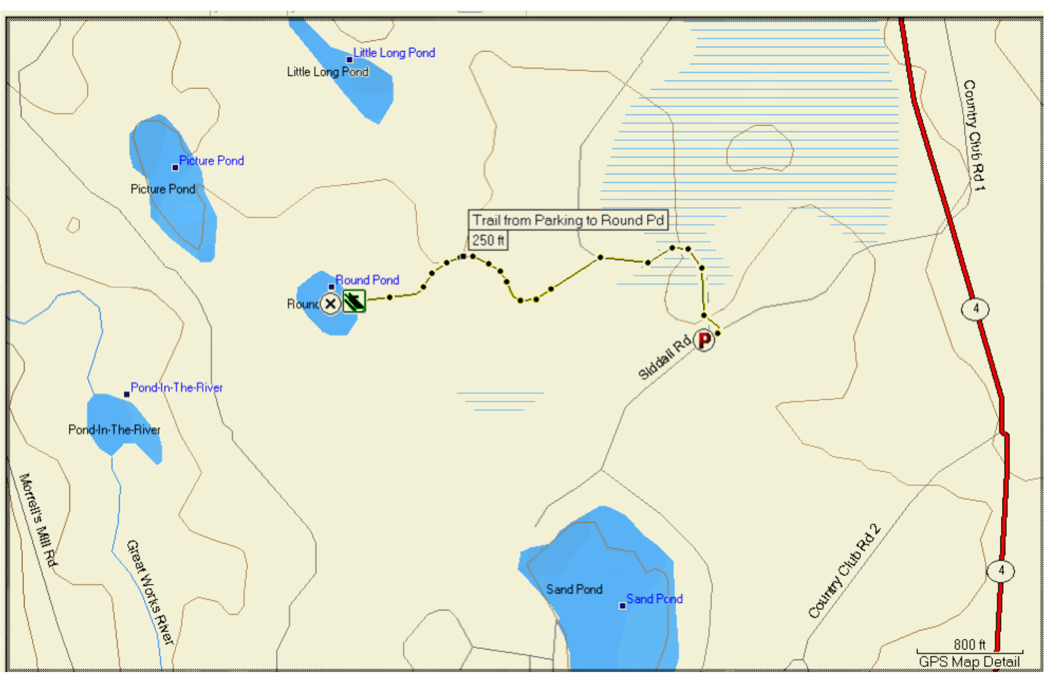
From Rt-4 in Dover, NH 40 min, 18.1 mi

- From Main St, turn onto Rt-4 **- 17.7 mi**
- Turn left at Sandy Point Rd. (dirt road, may require 4WD) **- 0.4 mi**
- At about 0.4 mi down Sandy Point Rd., park in the small inlet on the left. (the trail to Round Pond is about 100ft before the parking area on the right). Note: Sandy Point Rd. was previously called Siddall Rd.

Launch Site Description

After parking in the small dirt inlet on Sandy Point Rd., walk back about 100ft to the north side of Sandy Point Rd. where the trail to Round Pond. begins. This moderately used trail is 0.7 miles, and runs through a network of other trails, most of which seem to be used by ATV's. The area around the trail is very wet and muddy at the outset, and turns to a sandy, drier trail near the pond. Because trails are only moderately used and there are several trails, bring a GPS device to ensure arrival at the pond. Toward the end of the hike in, you will take a left at an obvious fork.
The trail from Sandy Point Rd. leads to the launch site which is directly in front of the trail facing west. At the launch site, the larger vegetation has been cleared but there is an abundance of emergent and floating vegetation which makes for a difficult launch. The floating/emergent vegetation surrounding the pond is too thick to paddle through and must be walked or waded through. Expect to get at least your legs wet when moving through the vegetation.





Sanford, Maine

Coordinates:

Sampling Point:
N 43.40166
W 70.75837

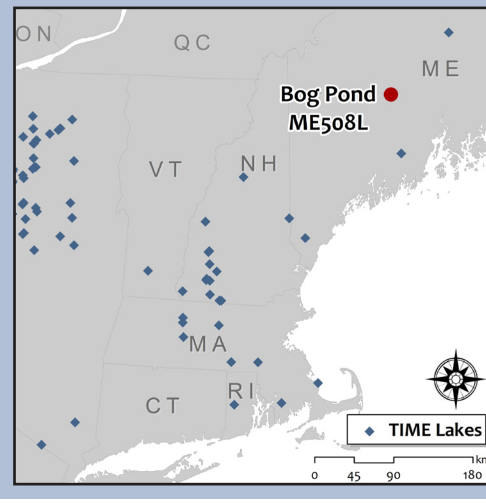
Launch Point:
N 43.40170
W 70.75772

Parking:
N 43.40090
W 70.74771

Bog Pond

Lake ID: ME508L

Other IDs/names: MIDAS: 2586

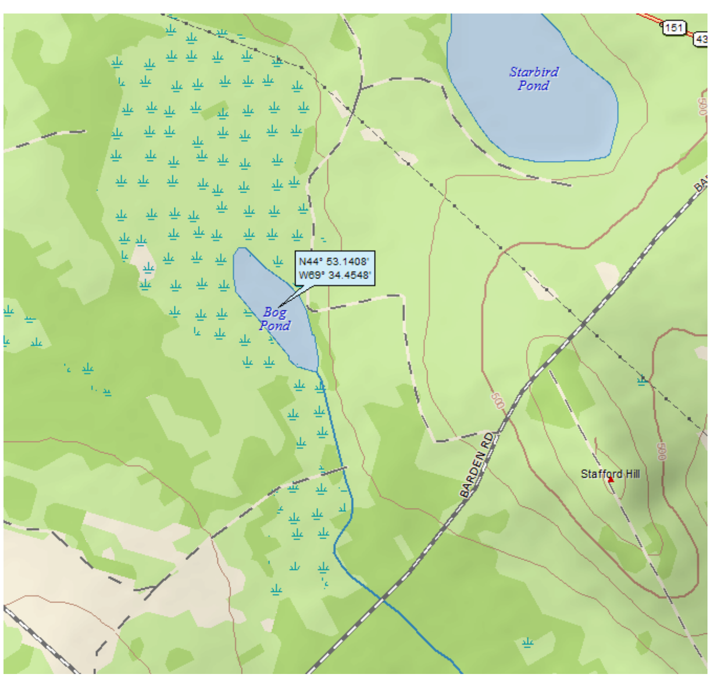


Lake description

Bog Pond is located in a rural area of Maine and is remote from houses and other development. It is small and very shallow. The pond is located in a floating peat bog, as its name suggests, and is darkly stained with high dissolved organic carbon (mean DOC=16.6 mg/L).

The pond is elongated, with a shoreline development index of 1.26.[1] Its outlet ultimately feeds into the Kennebec River. The area has low relief, with no major mountain ridges in the region. There have been logging operations in the watershed, but cut areas have regrown into a shrubby community.

Once surveyed for suitability of commercial peat harvests for energy, horticulture, and agricultural uses, Bog Pond is surrounded by large peat bog and wetland areas.[2] A follow-up enviromental classification of target peatlands reported that Bog Pond's deposit is "in the region of maximum marine invasion where bedrock is largely folded sedimentary, metasedimentary or layered volcanics, located in glacial drift in hills and mountains at the head of a stream. The deposit is in the form of an open to partly covered, moderately sloping heath with few pools."[3]



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1993, 1994, and 1995. Zooplankton species richness in Bog Pond was slightly greater than the median for all EMAP lakes.[4]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected.
Fisheries: There are no known survey data on presence or extirpation, based on Maine data sources.[6] Six fish data were listed in EMAP data tables for the 1993 and 1994 sampling, placing Bog Pond at the 25th percentile of all EMAP lakes.[4]
Birds: Sampled in 1993 and 1994, breeding bird species richness (43 species) was slightly greater than the 75th percentile across all EMAP lakes sampled.[4]

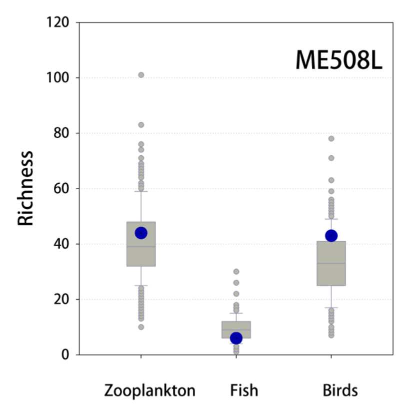


Figure ME508L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this pond (blue dots).

Bathymetry

No bathymetric map is available for Bog Pond. The EPA sampling team reported an index depth of 2.7 m at the sampling site at the northwest end of the pond. The 2012 sampling team reported depths of only 1.3 m across the pond.

Maine data from the Department of Environmental Protection, Inland Fisheries and Wildllife, and derived from GIS indicate a lake volume of 320,705 m^3 and flushing rate of 2.99 times/year.[1]

Table ME508L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	9.8
Watershed area (ha)	139.0
Mean depth (m)	1.21
Max depth (m)	no data
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	none since 1993
Topography	
Minimum watershed elevation (m)	120
Maximum watershed elevation (m)	172
Mean watershed slope (degrees)	1.0
Landcover (% of total watershed)	
Open water	7.1
Deciduous forest	19.0
Evergreen forest	2.1
Mixed forest	37.5
Shrub & Herbaceous	2.3
Agriculture (hay, cultivated)	0.5
Wetlands	27.7
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology (% of total watershed)	
Middle Paleozoic granitic rocks	

Table ME508L.2. Long-term chemistry for Bog Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	4.89	0.19	17
ClpH	pH units	4.86	0.17	17
ANC	$\mu eq \cdot L^{-1}$	-0.9	11.4	17
DOC	$mg \cdot L^{-1}$	16.55	2.87	17
Cond	$\mu S \cdot cm^{-1}$	18.3	3.3	17
Color*	Pt-Co units	177|139	26|40	11|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	42.8	8.4	17
Mg^{2+}	$\mu eq \cdot L^{-1}$	35.2	3.9	17
K^+	$\mu eq \cdot L^{-1}$	5.9	2.5	17
Na^+	$\mu eq \cdot L^{-1}$	41.8	4.0	17
Al (Total)	$\mu g \cdot L^{-1}$	172.4	32.2	17
SO_4^{2-}	$\mu eq \cdot L^{-1}$	26.4	11.7	17
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	17
Cl^-	$\mu eq \cdot L^{-1}$	17.6	4.5	17
SiO_2	$mg \cdot L^{-1}$	1.66	0.94	14
Total P	$\mu g \cdot L^{-1}$	30.8	14.8	9
Total N	$\mu g \cdot L^{-1}$	507	160	13

* Color is displayed as True|Apparent

Site disturbance & considerations

- The trail is easily lost and not well-maintained; footing is uneven.
- The pond can be very buggy in summer.
- Active logging has occurred around the pond throughout the sampling period.
- The EPA EMAP sampling team noted a beaver lodge at the pond in 1993. No other dams have been noted.

Photo date: August, 2012 • Credit: S. Nelson

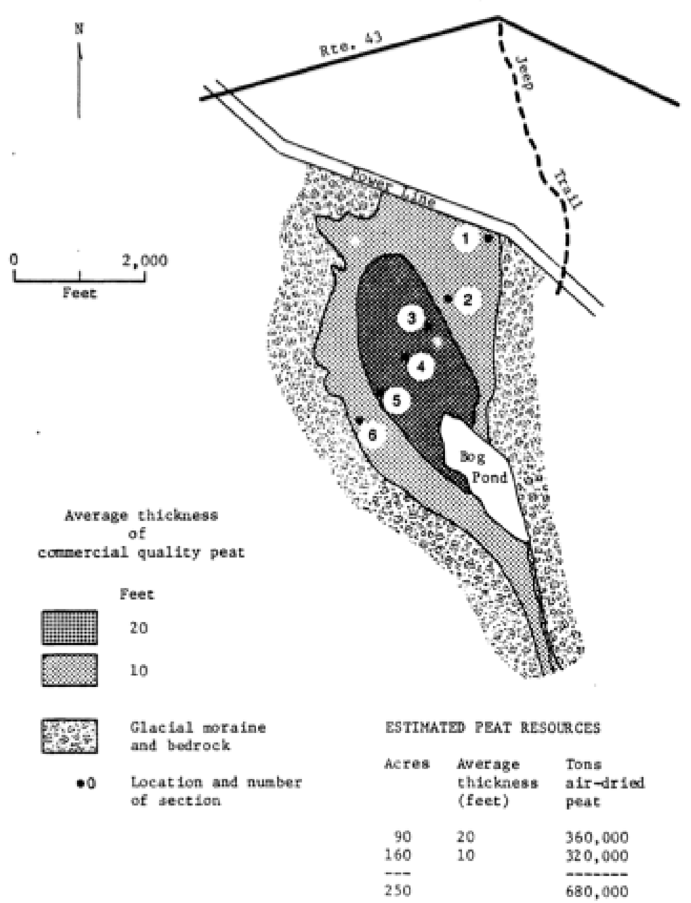
Sampling history and other studies at this lake

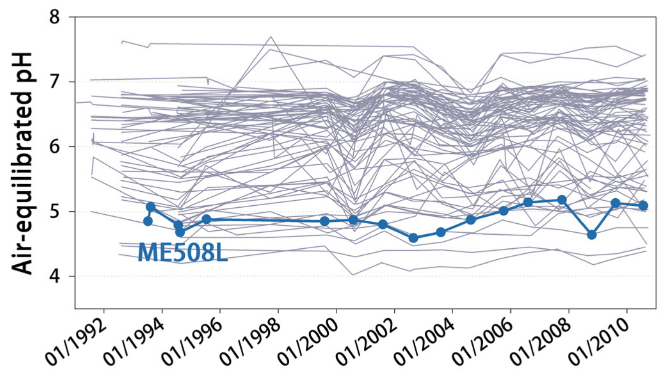
Bog Pond was cored once in 1993 and twice in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[4] Based on the EMAP core at Bog Pond, diatom-inferred pH was 6.4–6.46 in the bottom (pre-1850) section, and 5.25–5.5 in the top (recent) section.[4]

Few other data are available for Bog Pond. One study of peat resources at Bog Pond reported "commercial-quality" peat averaging 10–20 feet thick at the northern and western shores of the pond (Fig. ME508L.2).[2]

Bog Pond in 2002. Photo: Mitchell Center.

Figure ME508L.2. Sketch map of bog at Bog Pond southeast of Corson Corner, Hartland Twp., Somerset County, Maine. Source: Cameron, C.C., M.K. Mullen, 1982.[2]





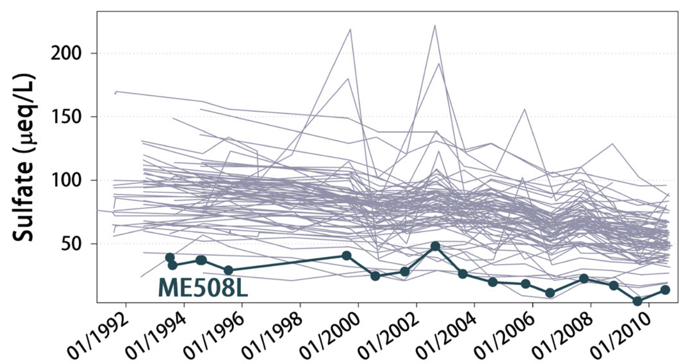
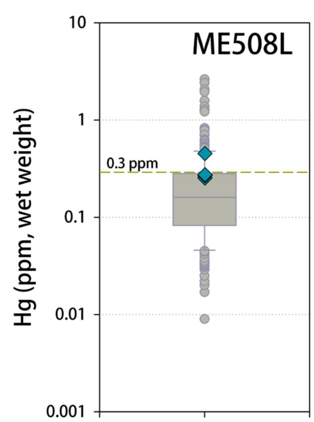


Figure ME508L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Bog Pond (thick blue line) has had among the lowest pH and lowest sulfate measurements in the TIME dataset. Because of its bog-like setting, the pond is probably naturally acidic.

Figure ME508L.4. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake (blue dot). Muddy Pond was sampled in 1993 and 1994. Its chain pickerel (*Esox niger*) samples averaged 0.322 ppm, wet weight. The value 0.3 ppm is the US EPA advisory level.



References

[1] Vaux and Entwood, 2010.

[2] Cameron and Mullen, 1982.

[3] Cameron, 1983.

[4] US EPA, 2012.

[5] Nelson *et al.*, 2011.

[6] Dembeck, 2009.

Site access

From Bangor, ME — 1 hr., 46.4 mi

- Take the ramp onto I95 S/ME15 S - **26.4 mi**
- Take exit 157 for ME11/ME100 toward US2/Newport/Skowhegan - **0.3 mi**
- Keep right at the fork, follow signs for 2/7/11/100 and merge onto ME100/ME11/Hwy - **0.2 mi**
- Turn left onto Banhs Rd - **308 ft**
- Turn left onto US2 W - **6.6 mi**
- Turn right onto ME152/Estes Ave - **4.2 mi**
- Turn left onto Main St - **230 ft**
- Take the 2nd right onto Pleasant St - **0.6 mi**
- Continue onto ME151 N/ME43 W/Athens Rd - **5.8 mi**
- Turn left onto Barden Rd (may be unmarked - private, dirt road) - **1.4 mi - END**
- Park on dirt road before it splits into smaller, less traveled roads at a cleared area just beyond plantation pines on left.

Launch Site Description

Continue down the road on foot, from the clearing where you parked. In about 200 yards, a tree with multiple red blazes marks the start of the trail (there is a No Trespassing sign here as well); bear to the right. Pond is about 0.75 miles from parking area. Launch from the south end of the pond; northern shorelines are floating bogs with peat averaging 20 feet deep.

Hartland, Maine

Coordinates:

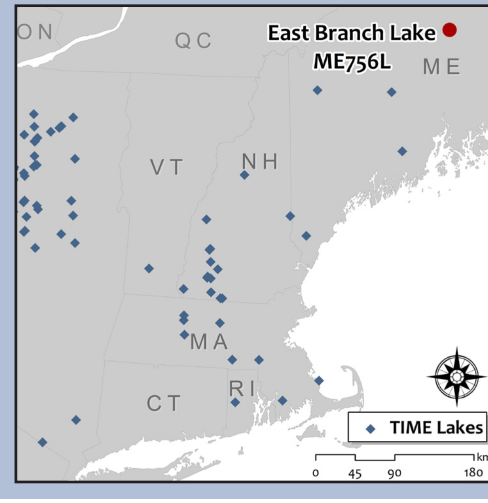
Sampling Point:
N 44.88550
W 69.57481

Launch Point:
N 44.88353
W 69.57172

Parking:
N 44.88033
W 69.56531

East Branch Lake

Lake ID: ME756L
Other IDs/names: MIDAS: 2130; GNIS ID: 565548

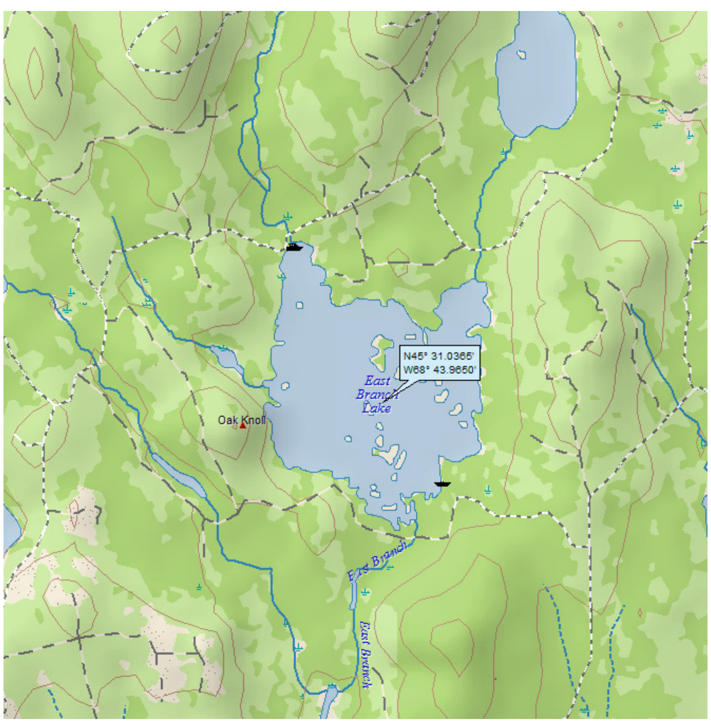


Lake description

East Branch Lake is a remote, warmwater lake located in the headwaters of the Seboeis Stream drainage. Although it is quite large (1,100 acres), the lake is shallow, with a maximum depth of only ~23 ft (7 m). Almost all of the lakeshore is owned by the Penobscot Indian Nation, who conduct regular monitoring of lake water quality. The watershed is a nearly continuous softwood forest draped across gently rolling hills.

The shoreline is dominated by boulders, a few ledge outcroppings, and white sand beaches. There are several small islands, from a half to several acres in size, also dominated by boulders along the shore and heavily forested with softwoods. The shoreline development index is 3.05. Substrate tends to be gravel, cobble, and large boulders in this shallow lake. At the southern end, near the outlet (East Branch Sebois Stream), more mucky substrate and wetland-type shoreline dominate.

The lake does not thermally stratify. There is abundant oxygen at all depths, although there may be some dissolved oxygen deficiency observed in the small "deep hole" near sampling station #1 in late summer.[1] The lake's flushing rate is estimated at 1.11 times/yr, and lake volume is 13,349,974 m^3.[2]



Biota

Zooplankton: Sampled in 1994, EMAP zooplankton surveys identified 49 species, slightly greater than the 75th percentile compared to all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: A 1989 Maine survey lists 10 fish species, similar to the 12 species (75th percentile across EMAP lakes) found in the 1994 EMAP survey.[3] The lake is a warmwater fishery.[1]

Birds: Breeding bird richness was somewhat low compared to all EMAP lakes.[3]

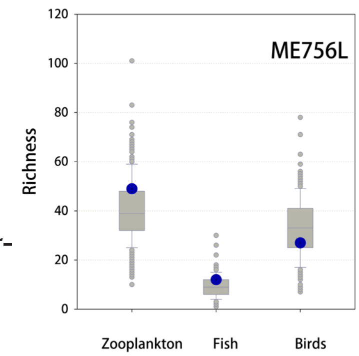
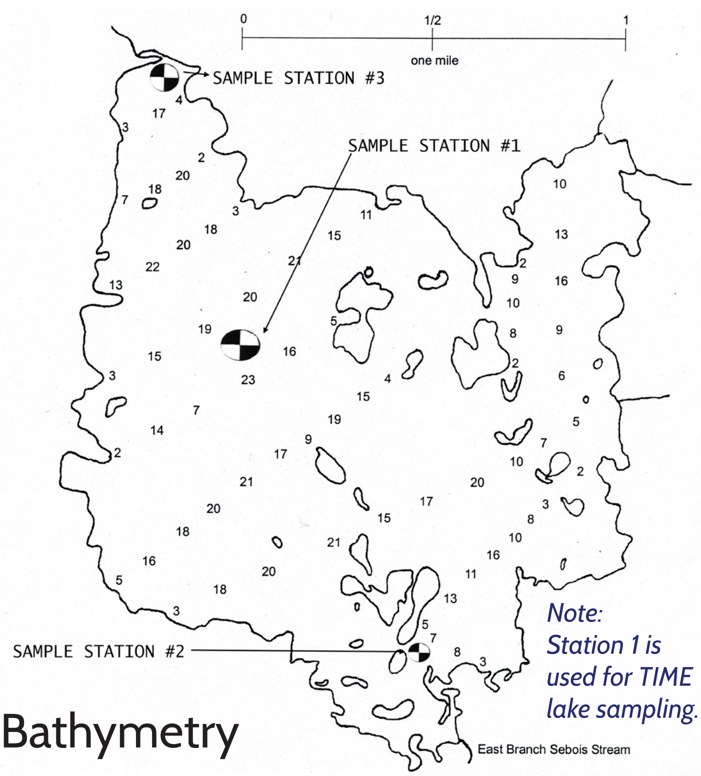


Figure ME756L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).



Note: Station 1 is used for TIME lake sampling.

Bathymetry

Table ME756L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	475.8
Watershed area (ha)	3545.9
Mean depth (m)	4.13[3]
Max depth (m)	6.4[2]
Drainage class	drainage
Number of inlets	5 (1 perennial)
Number of outlets	1
Flow alteration	none
Topography	
Minimum watershed elevation (m)	122
Maximum watershed elevation (m)	290
Mean watershed slope (degrees)	2.5
Landcover (% of total watershed)	
Open water	13.8
Deciduous forest	15.1
Evergreen forest	32.7
Mixed forest	25.7
Shrub & Herbaceous	7.8
Wetlands	6.6
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology (% of total watershed)	
• Middle Paleozoic granitic rocks (84%) • Devonian eugeosynclinal (8%) • Silurian eugeosynclinal (8%)	

Table ME756L.2. Long-term chemistry for East Branch, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.81	0.12	13
ClpH	pH units	6.47	0.13	13
ANC	$\mu eq \cdot L^{-1}$	59.4	6.8	13
DOC	$mg \cdot L^{-1}$	5.51	0.89	13
Cond	$\mu S \cdot cm^{-1}$	18.4	2.1	12
Color*	Pt-Co units	16|26	5|6	7|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	93.7	6.6	13
Mg^{2+}	$\mu eq \cdot L^{-1}$	28.3	2.4	13
K^+	$\mu eq \cdot L^{-1}$	7.5	0.7	13
Na^+	$\mu eq \cdot L^{-1}$	43.5	4.5	13
Al (Total)	$\mu g \cdot L^{-1}$	50.7	30.6	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	60.2	13.8	13
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	13
Cl^-	$\mu eq \cdot L^{-1}$	16.7	3.2	13
SiO_2	$mg \cdot L^{-1}$	2.69	0.82	10
Total P	$\mu g \cdot L^{-1}$	5.1	1.6	5
Total N	$\mu g \cdot L^{-1}$	197	29	8

* Color is displayed as True|Apparent

Site disturbance & considerations

- Almost the entire lakeshore and watershed is forested in softwood vegetation, with little evidence of disturbance.
- In 2012, the Penobscot Nation began building a wooded picnic area and campground on the eastern shore of the lake.
- There are four private camps and three tribally-owned camps on the lake.

A mink on one of the several islands in East Branch Lake. Photo: S. Nelson, 2012.

Sampling history and other studies at this lake

East Branch Lake was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages.[3] Based on the EMAP core at East Branch Lake, diatom-inferred pH was 6.97 in the bottom (pre-1850) section, and 7.14 in the top (recent) section.[3]

A 1996 study evaluating freshwater mussels across Maine reported three species in East Branch Lake: triangle floater (*Alasmidonta undulata*), Eastern elliptio (*Elliptio complanata*), and Eastern floater (*Pyganodon cataracta*).[5]

Penobscot Indian Nation Water Resources Program (PINWRP) conducts water quality monitoring at East Branch Lake approximately monthly during June-October, with more intensive sampling on a ~4 year rotational basis (twice/month) for the purpose of determining Trophic Status Indices (TSI) for the lake (using ME DEP Lake Assessment Criteria). Because color >25 SPU in East Branch Lake, TSI is derived from chlorophyll-a and was 34.3 in 2009, characterizing the lake as mesotrophic. Parameters regularly monitored by PIN WRP at East Branch Lake include: dissolved oxygen and temperature at 1m profiles; Secchi transparency; alkalinity; apparent color; *E. coli* bacteria; chlorophyll-a; total phosphorous; conductivity; and closed cell pH. PIN WRP has also done some testing of fish tissues for mercury, and more intensive seasonal sampling during spring runoff (pH, alkalinity, and aluminium) to determine potential for episodic acidification.

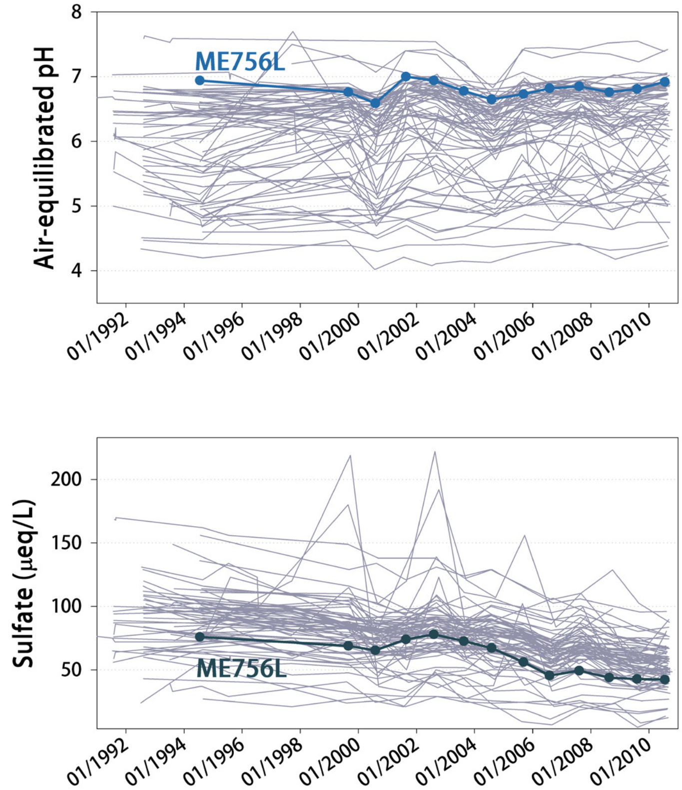


Figure ME756L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). East Branch Lake (thick blue line) has had among the highest pH and lowest sulfate measurements in the TIME dataset. Sulfate has steadily declined through the TIME sampling period.

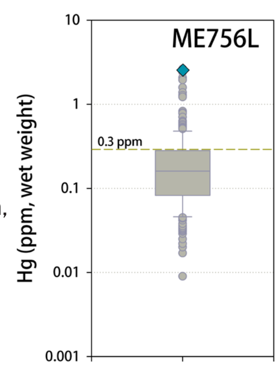


Figure ME756L.4. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot). East Branch Lake was sampled in 1994. Its smallmouth bass (*Micropterus dolomieu*) sample was 2.63 ppm, wet weight, the highest in the EMAP dataset. The value 0.3 ppm is the US EPA advisory level.

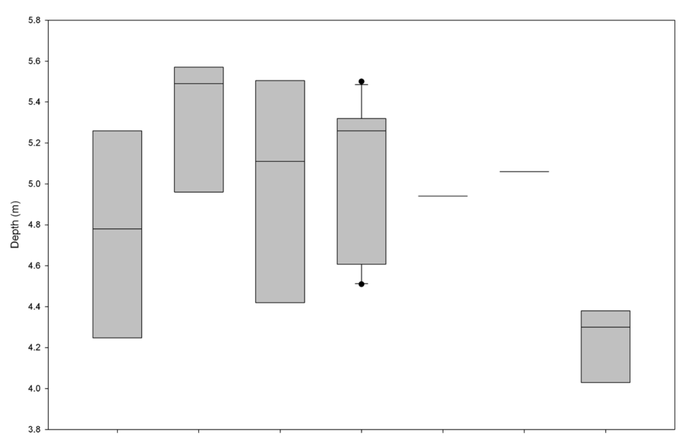


Figure ME756L.3. East Branch Lake Secchi disk transparency (in meters) since 2006. Tranparency typically ranged between 4-5.5 meters. Figure courtesy of D. Kuznierz, PINWRP.

References

[1] Maine IF&W, 1989.
[2] Vaux and Entwood, 2010.
[3] US EPA, 2012.
[4] Nelson *et al.*, 2011.
[5] Nedeau *et al.*, 2000.

Photo date: August, 2012 • Credit: S. Nelson

Site access

From Orono, ME

1 hr 50 min, 70 mi

- Take I95 N toward Howland – **8.4 mi**
- Take exit 199 toward Alton/LaGrange/Milo - **0.3 mi**
- Merge onto ME16 W/Bennoch Rd - **24.2 mi**
- Turn right onto E Main St - **440 ft**
- Continue onto ME11 N/Park St - **28.9 mi**
- Turn right onto Cedar Lake Rd - **3.2 mi**
- Slight left onto Fire Rd 2 - **2.4 mi**
- Turn left - **0.8 mi**
- Turn left - **1.8 mi**
- Note: Cedar Lake Road and other roads past this point are dirt roads.

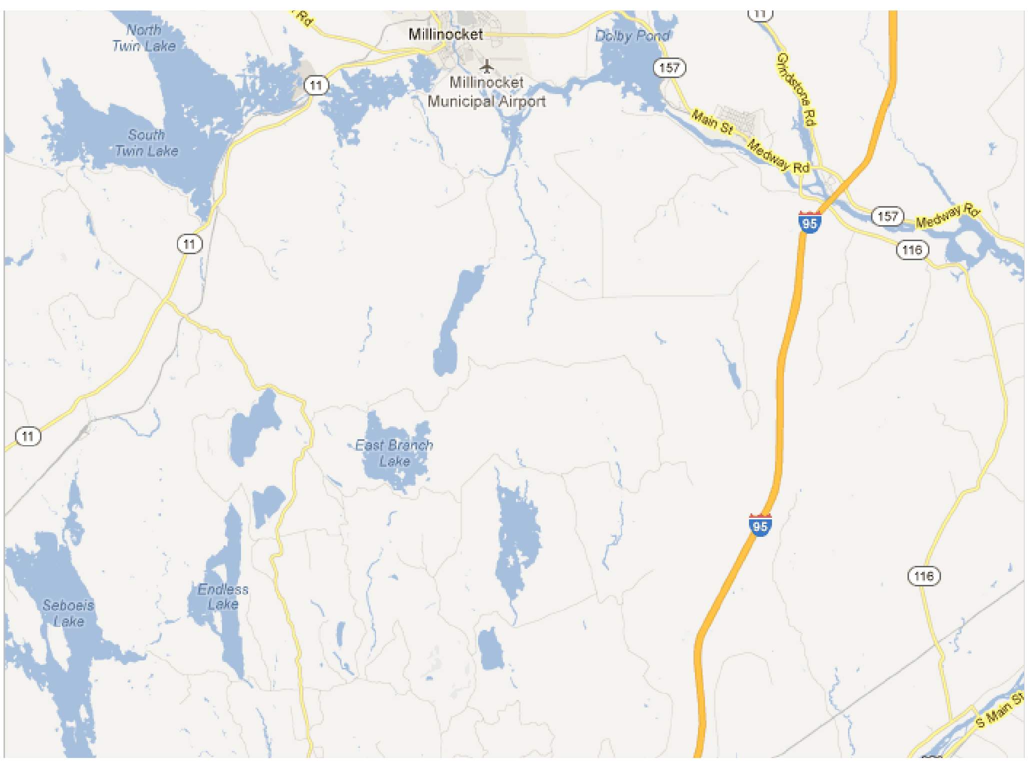
View from launch toward sampling station

Launch Site Description

Launch from public ramp on north end of lake. This is a large, trailerable boat ramp with parking for several vehicles. Note: This lake is sampled by the Penobscot Indian Nation. Lake access is not on tribal land, but much of the area surrounding the lake is tribally owned. Any research activities on the lake need to be coordinated with the Penobscot Nation.

One of several rock-bound islands in the lake

Launch



T3 R9 NWP, Maine

Coordinates:

Sampling Point:
N 45.51639
W 68.74410

Launch Point:
N 45.53267
W 68.74694

Parking:
N 45.53267
W 68.74694

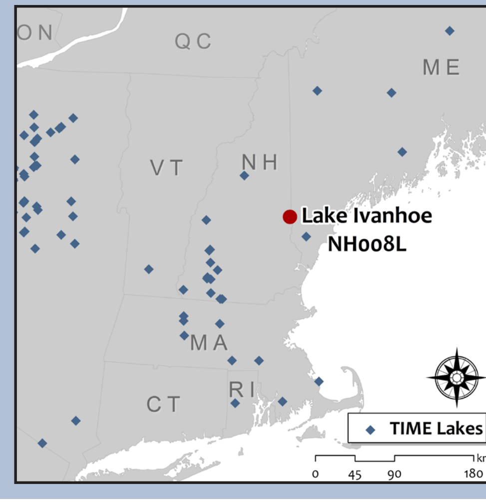
Local Contact:

Dan Kusnierz, Penobscot Indian Nation, 207-827-7776; Dan.Kusnierz@penobscotnation.org

Lake Ivanhoe

Lake ID: NH008L

Other IDs/names: Round Pond, Little Round Pond

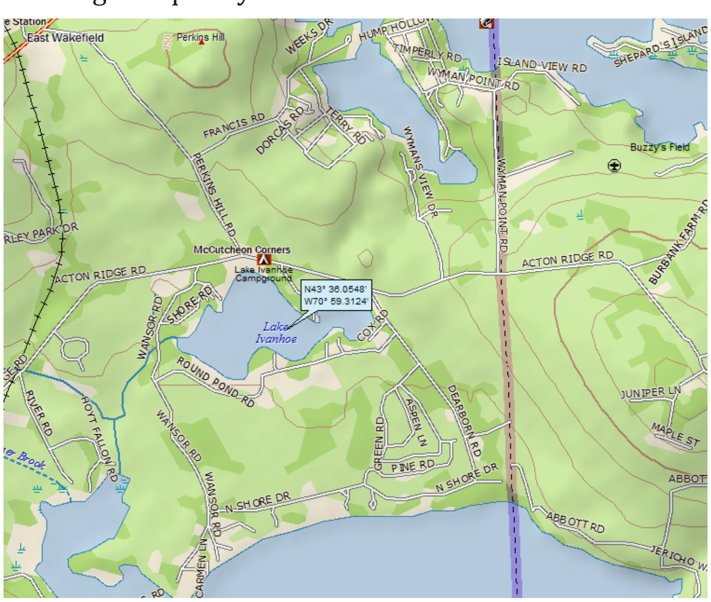


Lake description

Ivanhoe Pond has a fairly high amount of human activity and many residential homes along its shores, plus a campground. There are a pair of nesting loons that inhabit the pond and are regularly monitored by the Loon Preservation Committee. Several groups have collectively monitoring water quality in the lake since 1981: the UNH Lay Lakes Monitoring Program (LLMP) and Center for Freshwater Biology (CFB), and NH Department of Environmental Services (NHDES).[1]

Although it was considered oligotrophic,[2] the lake is shallow and does not stratify; it has recently been listed as impaired due to nutrient (phosphorus) inputs and is considered a lake that has had good water quality quickly reach a tipping point toward impairment due to human activity in the watershed. Mean Secchi disk transparency (1981–2007) has been 4.8 m at one monitoring site and 5.1 m at a second site.[1]

According to a recent, detailed study of lakes in the larger watershed containing Ivanhoe, "[h]istorically, a small stream drained the lake at its western end, crossing Wansor Road, and then south through a small area of forest and into Great East Lake. Local residents report that the stream outlet was filled in years ago during a construction project, and that water flowing out of Lake Ivanhoe is currently flowing over land toward Great East Lake causing serious flooding problems including flooding of septic systems."[1]



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1991 and 1995. Zooplankton species richness in Round Pond was slightly less than the median for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected. Snails were the only other taxa observed.

Fisheries: Smallmouth bass, pickerel, and horned pout are listed in the fishing guide for Round Pond in Wakefield.[5] No fish data were listed in EMAP data tables.[3]

Birds: Breeding bird richness, sampled in 1995. was slightly greater in Lake Ivanhoe than the median across all EMAP lakes.[3]

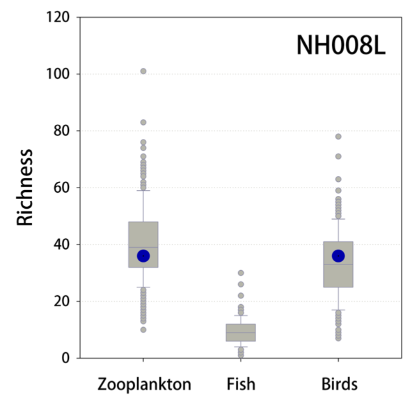


Figure NH008L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, (blue dots).

Bathymetry

Mean Depth: 12 feet (3.7 m)

Max Depth: 20 feet (6.1 m)

Surface Area: 68 acres (0.12 mi^2)

Volume: 992,000 m^3

Perimeter: 8,858 feet

Flushing Rate: 0.90 flushes/year

Avg. Transparency: 5.1 meters (19 ft)

Watershed Area: 455 acres (0.71 mi^2)

Drains to: Great East Lake

Major Drainage Basin: Salmon Falls River

Figure NH008L.2. Morphometric characteristics for Lake Ivanhoe. Data Source: FB Environmental Inc., 2010.[1]

Table NH008L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	25.5
Watershed area (ha)	89.0
Mean depth (m)	3.7[1]
Max depth (m)	6.1[1]
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	possible filling of outlet
Topography	
Minimum watershed elevation (m)	183
Maximum watershed elevation (m)	214
Mean watershed slope (degrees)	1.6
Landcover (% of total watershed)	
Open water	30.8
Developed, open space and low-intensity (<50% impervious)	9.9
Developed, medium to high density (≥50% impervious)	1.5
Deciduous forest	18.9
Evergreen forest	16.2
Mixed forest	19.6
Wetlands	3.2
Mean Impervious surface (% of total watershed)	2.1
Bedrock Geology	
Devonian eugeosynclinal	

Table NH008L.2. Long-term chemistry for Lake Ivanhoe, 1991-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.83	0.18	18
ClpH	pH units	6.54	0.20	17
ANC	$\mu eq \cdot L^{-1}$	48.5	8.0	18
DOC	$mg \cdot L^{-1}$	3.00	0.55	18
Cond	$\mu S \cdot cm^{-1}$	66.7	14.7	18
Color*	Pt-Co units	4|8	2|6	12|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	78.2	8.9	18
Mg^{2+}	$\mu eq \cdot L^{-1}$	29.3	2.4	18
K^+	$\mu eq \cdot L^{-1}$	14.8	1.5	18
Na^+	$\mu eq \cdot L^{-1}$	430.9	102.7	18
Al (Total)	$\mu g \cdot L^{-1}$	6.7	4.4	18
SO_4^{2-}	$\mu eq \cdot L^{-1}$	58.3	5.5	18
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	18
Cl^-	$\mu eq \cdot L^{-1}$	434.0	121.6	18
SiO_2	$mg \cdot L^{-1}$	0.16	0.13	14
Total P	$\mu g \cdot L^{-1}$	7.9	2.7	10
Total N	$\mu g \cdot L^{-1}$	227	63	14

* Color is displayed as True|Apparent

Site disturbance & considerations

- Be certain to sample the correct basin of Ivanhoe; the lake is large and irregular. A kayak or canoe are ideal for sampling.
- Be prepared to talk with local residents.
- Parking is limited at the boat ramp.
- Other monitoring programs tend to focus sampling on "Station 2", the 'deep hole' in the large, western basin, consistent with the TIME site.
- In addition to road salt contamination, there are many properties that lack buffer strips all along the lakeshore.

Sampling history and other studies

Lake Ivanhoe was cored once in 1991 and once in 1995 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Lake Ivanhoe, diatom-inferred pH was 5.56–5.84 in the bottom (pre-1850) section, and 6.52–7.21 in the top (recent) section.[3] NH DES lists monitoring data for pH in Lake Ivanhoe in 1981 (pH=6.3) and 1992 (6.7).[2]

Lake Ivanhoe (EPA ID NHLAK600030403-03) has been impaired based on the aquatic life use (due to pH) in 2002 and 2004, and fish consumption use (due to mercury) in 2002, 2004, 2006, and 2008.[6] TMDLs are in place for both impairments.[6] A 0.8 ppb reduction in total phosphorus was recommended for Lake Ivanhoe in the Salmon Falls Watershed Management Plan.[1]

The Salmon Falls Watershed Management Plan includes a synthesis of water quality monitoring data and a detailed watershed survey, focused on assessing potential impairment of the Lake due to human use of the watershed.[1] The watershed survey found that one logging road/construction area, one town road, and residential properties were the largest sources of soil erosion, contributing almost all of the 35.2 tons/year of estimated soil loss to the lake.[1] The plan also gives details regarding septic systems in the watershed, landcover, and buildout scenarios.

The New Hampshire Volunteer Lake Assessment Program also samples Lake Ivanhoe each year. In 2011, they assessed trends in lakes with 10 or more years of data, and reported improving trends for Chlorophyll-a, transparency (Fig. NH008L.3), and epilimnetic phosphorus in Lake Ivanhoe.[7]

Lake Ivanhoe was also sampled as part of NH/VT REMAP in 1998.[8] Data include mercury concentrations in piscivores as well as water chemistry.

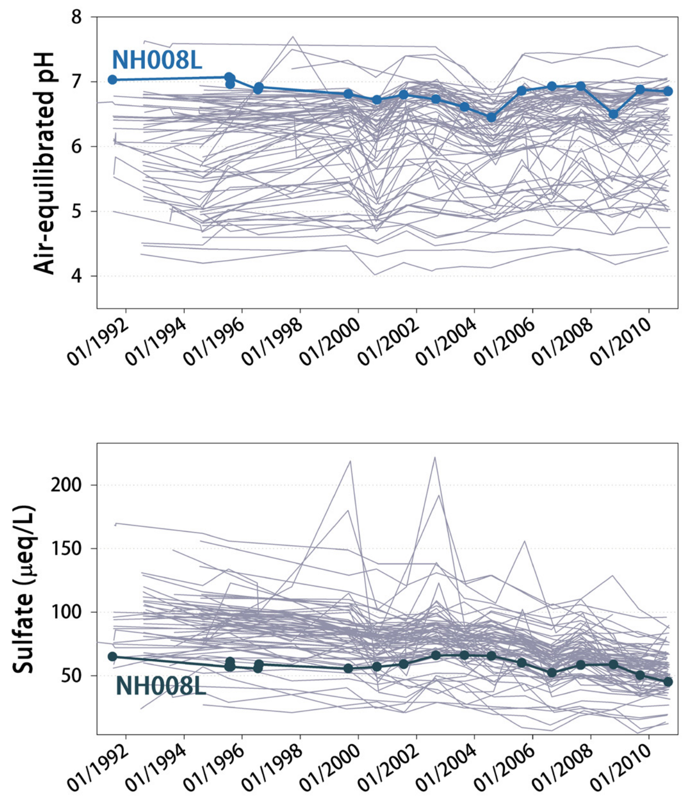


Figure NH008L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Lake Ivanhoe (thick blue line) has had among the highest pH, consistent through the TIME sampling period.

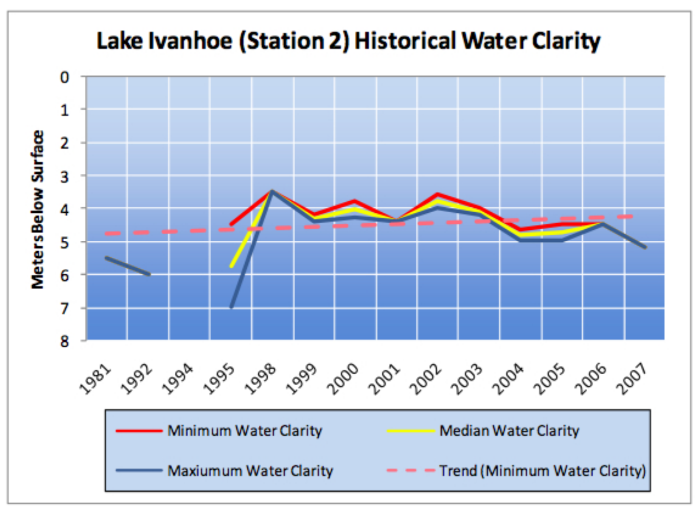


Figure NH008L.3. Median, maximum, and minimum transparency (water clarity) for Lake Ivanhoe's 'deep hole' (Station #2), 1981-2007. Figure from *Lake Fact Sheets*, in FB Environmental Associates, Inc., 2010.[1]

References

[1] FB Environmental Associates, Inc., 2010.
[2] NH DES, 2009.
[3] US EPA, 2012.
[4] Nelson *et al.*, 2011.
[5] NH Fish and Game Department, 2009.
[6] US EPA, 2013.
[7] Steiner, 2012a.
[8] Kamman *et al.*, 2004.

Site access

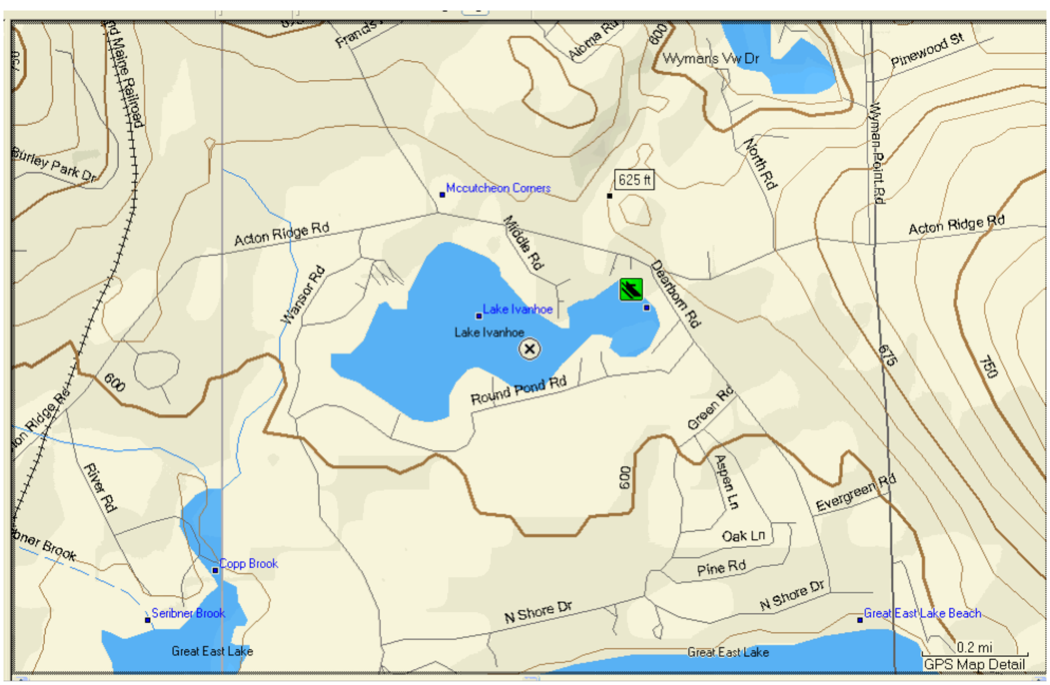
From Concord, U.S. 202

1 hr 23 min, 58.5 mi

Head East on U.S. 202 - **10.1 mi**
At the traffic circle, continue straight onto NH-9 E/US-4 E/U.S. 202 - **11.4 mi**
Turn left at NH-9 E/U.S. 202 E; Continue to follow U.S. 202 E - **11.7 mi**
Slight right onto the Spaulding Turnpike S/New Hampshire 16 S ramp - **0.2 mi**
Sharp left at NH-16/Spaulding Turnpike; Continue to follow NH-16 - **19.2 mi**
8.Turn right at NH-109 S/Meadow St - **0.8 mi**
Turn left at NH-153 N/Wakefield Rd; Continue to follow NH-153 N - **3.5 mi**
Turn right at Acton Ridge Rd - **1.6 mi**
Slight right at Dearborn Rd - **143 ft**
Park just past boat launch on right - **END**

Launch Site Description

Although not well marked, the public boat launch is easily accessible. After turning onto Dearborn Rd, the launch will be almost immediately on your right. Park just past the launch on the same side of the road.



East Wakefield, New Hampshire

Coordinates:

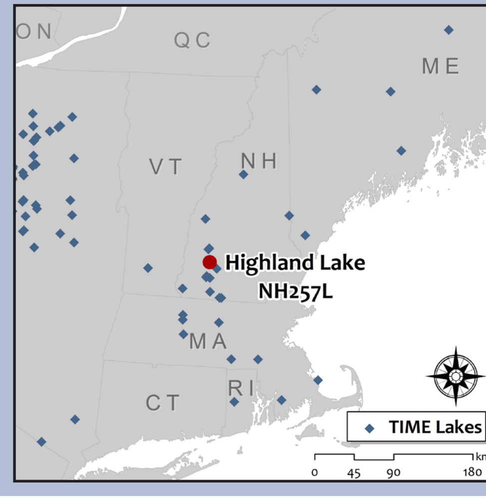
Sampling Point:
N 43.60107
W 70.98854

Launch Point:
N 43.60236
W 70.98336

Highland Lake

Lake ID: NH257L

Other IDs/names: NHLAK700030201-03



Lake description

Highland Lake is shallow, long and narrow with an approximate surface area of 721 acres and a mean depth of 2.4 m; the lake is mesotrophic.[1] Most of the shoreline has residential homes; however, 40% of the watershed is currently protected land.[2] The area is hilly, with mixed forests in the watershed. There is a dam at the north end of the lake.

There appears to be more than one lake association, but the umbrella association that performs lake water quality and invasive plant monitoring is the Highland Lake Unified Association.[3]

A comprehensive lake inventory, which included rankings of recreational value (moderate-high), unique or outstanding value (moderate-high), and susceptibility to impairment (low-moderate), as well as a watershed management plan, were developed for Highland Lake in 2010.[2]

The Highland Lake watershed supports five exemplary natural communities identified by the New Hampshire Natural Heritage Bureau."[2] There are five NH threatened and endangered species in the watershed: *Gavia immer* (common loon), *Arethusa bulbosa* (Arethusa), *Dryopteris goldiana* (Goldie's fern), *Hippuris vulgaris* (common mare's tail), and *Myriophyllum farwellii* (Farwell's water milfoil).[2]

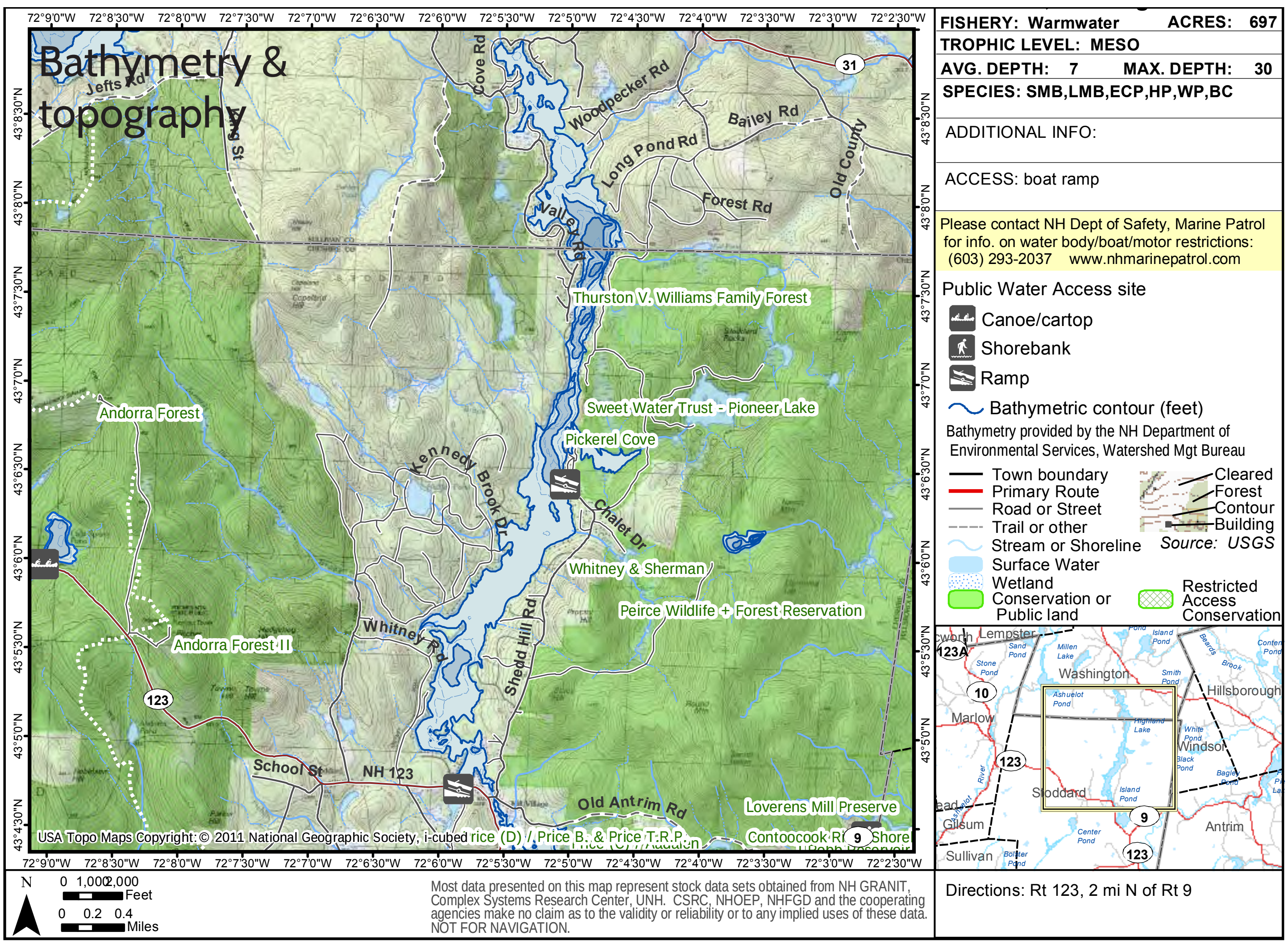


Table NH257.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	300.8
Watershed area (ha)	7448.8
Mean depth (m)	2.4[1]
Max depth (m)	9.1[1]
Drainage class	reservoir
Number of inlets	>12
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	395
Maximum watershed elevation (m)	752
Mean watershed slope (degrees)	6.6
Landcover (% of total watershed)	
Open water	5.2
Developed, open space and low-intensity (<50% impervious)	3.2
Deciduous forest	39.7
Evergreen forest	14.9
Mixed forest	31.1
Shrub & Herbaceous	0.6
Agriculture (hay, cultivated)	1.0
Wetlands	6.7
Mean Impervious surface (% of total watershed)	0.4
Bedrock Geology (% of total watershed)	
• Middle Paleozoic granitic rocks (77%) • Devonian and Silurian eugeosynclinal (23%) • Devonian eugeosynclinal (<1%)	

Table NH257L.2. Long-term chemistry for Highland Lake, 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.65	0.13	12
ClpH	pH units	6.17	0.19	12
ANC	$\mu eq \cdot L^{-1}$	43.2	7.5	12
DOC	$mg \cdot L^{-1}$	5.48	1.27	12
Cond	$\mu S \cdot cm^{-1}$	32.6	5.3	12
Color*	Pt-Co units	26|32	11|15	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	85.3	8.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	33.9	3.0	12
K^{+}	$\mu eq \cdot L^{-1}$	9.1	2.1	12
Na^{+}	$\mu eq \cdot L^{-1}$	148.1	27.6	12
Al (Total)	$\mu g \cdot L^{-1}$	64.2	40.1	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	73.3	12.6	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	127.7	33.8	12
SiO_2	$mg \cdot L^{-1}$	1.03	1.18	10
Total P	$\mu g \cdot L^{-1}$	9.3	2.9	5
Total N	$\mu g \cdot L^{-1}$	263	71	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Be aware of larger boats while sampling, and use caution due to the shallow character of the lake.
- Invasive aquatic plants have not been found in the lake, despite heavy recreational usage. Be aware that local lake associations conduct boat checks at launches.
- The lake has had elevated *E. coli* levels.[4]

Sampling history and other studies

Highland Lake was not cored in the 1991-1995 EMAP sediment survey.

Highland Lake (EPA ID NHLAK700030201-03) has been impaired based on fish consumption use in 2008. A TMDL is in place.[4] It was assessed and was in good condition with respect to primary contact, secondary contact, and drinking water after treatment, also in 2008. *E. coli* and water temperature were measured at two sites at Highland Lake in 2009; Highland Lake Boat Launch was then listed as impaired for primary contact due to *E. coli* in 2010. Data are available in EPA WATERS or STORET.[4]

In 2011, the New Hampshire Volunteer Lake Assessment Program's trend assessment reported an improving trend for Chlorophyll-a, stable trend for transparency, and stable trend for epilimnetic phosphorus in the southern sampling station but variable trend in the northern basin for Highland Lake.[5] Average transparency in Highland Lake was less than the NH median (3.2 m) and the regional median (3.8 m).[5] NH DES lists monitoring data for pH and other basic chemistry in Highland Lake in 1979 (pH=5.7), 1993 (pH=6.2), 2004 (pH=5.96), and 2007 (pH=5.89).[1] These pH values are lower than TIME measurements, but probably are not equilibrated and therefore reflect biotic activity in this shallow, mesotrophic lake.

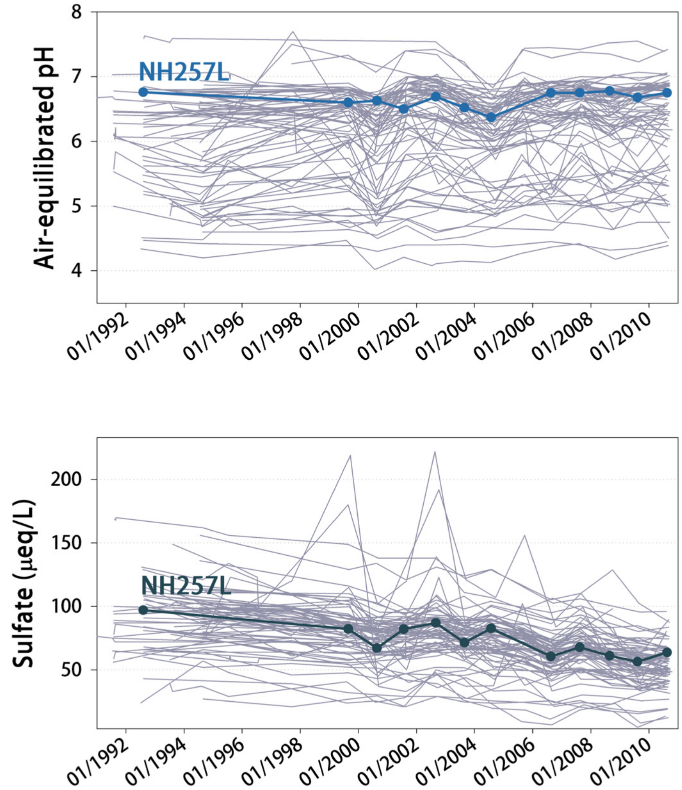


Figure NH257L.1. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Highland Lake (thick blue line) has had moderately high pH and moderate sulfate among TIME lakes. Sulfate has steadily declined since sampling began, whereas pH has remained constant.

Biota

Zooplankton: Based on 1992 EMAP zooplankton sampling, species richness in Highland Lake was slightly greater than the median for all EMAP lakes.[6]

Although other taxa were not listed in EMAP databases, wildlife diversity was important in the 2010 inventory and ranking with nine species of warmwater fish, 15 species of reptiles and amphibians, 26 species of aquatic or water-dependent birds and six species of aquatic or water-dependent mammals, many of which "rely on the numerous shallow coves and embayments that provide food and cover."[2]

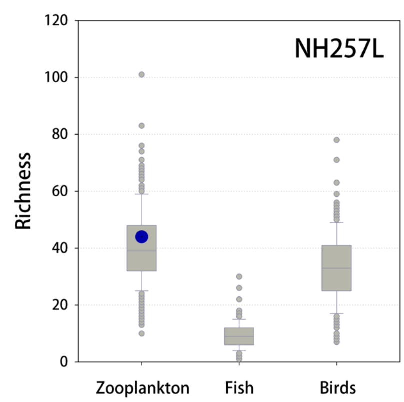


Figure NH257LL.2. Zooplankton, bird, & fish species richness for all EMAP lakes sampled 1991-1995[6] (gray box plot) and for this lake (blue dot).

Photo date: August, 2012 • Credit: A. Baumann

References

[1] NH DES, 2009.

[2] Upper Valley Lake Sunapee Regional Planning Commission , 2010.

[3] http://www.stoddardnh.org/schools-clubs-organizations/highland-lake-unified-association

[4] US EPA, 2013.

[5] Steiner, 2012b.

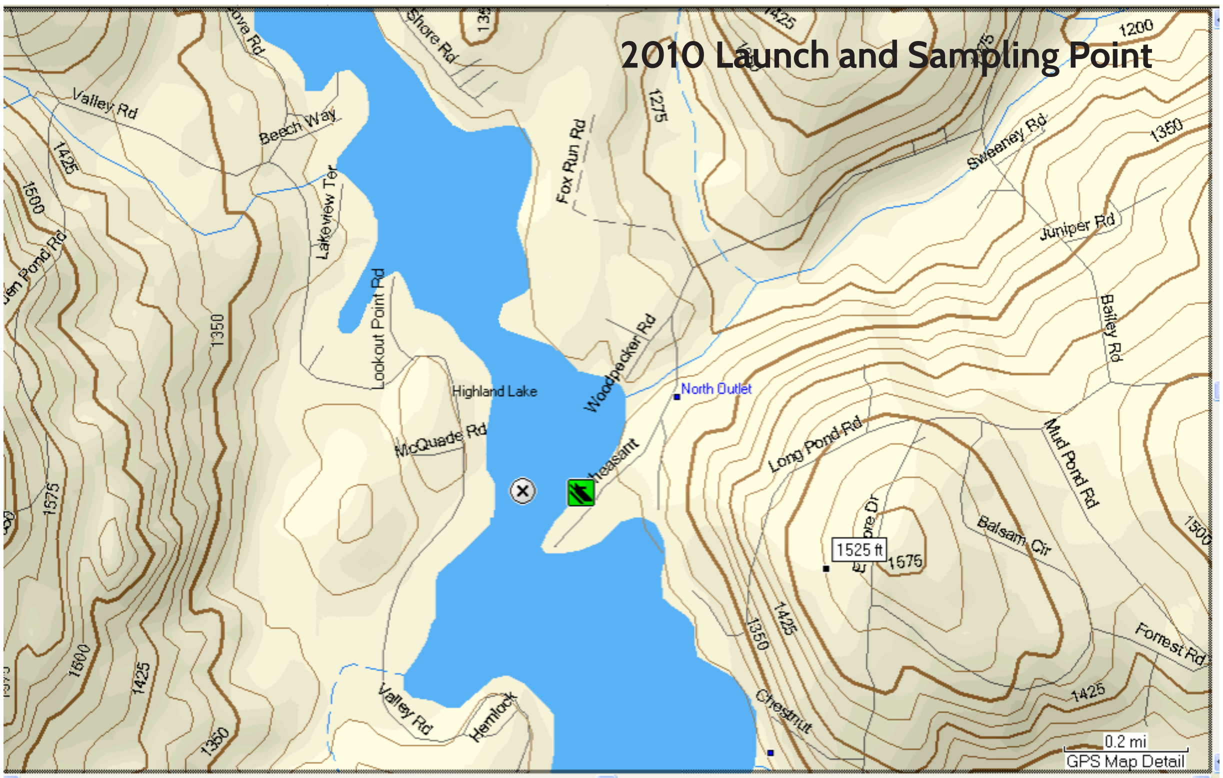
[6] US EPA, 2012.

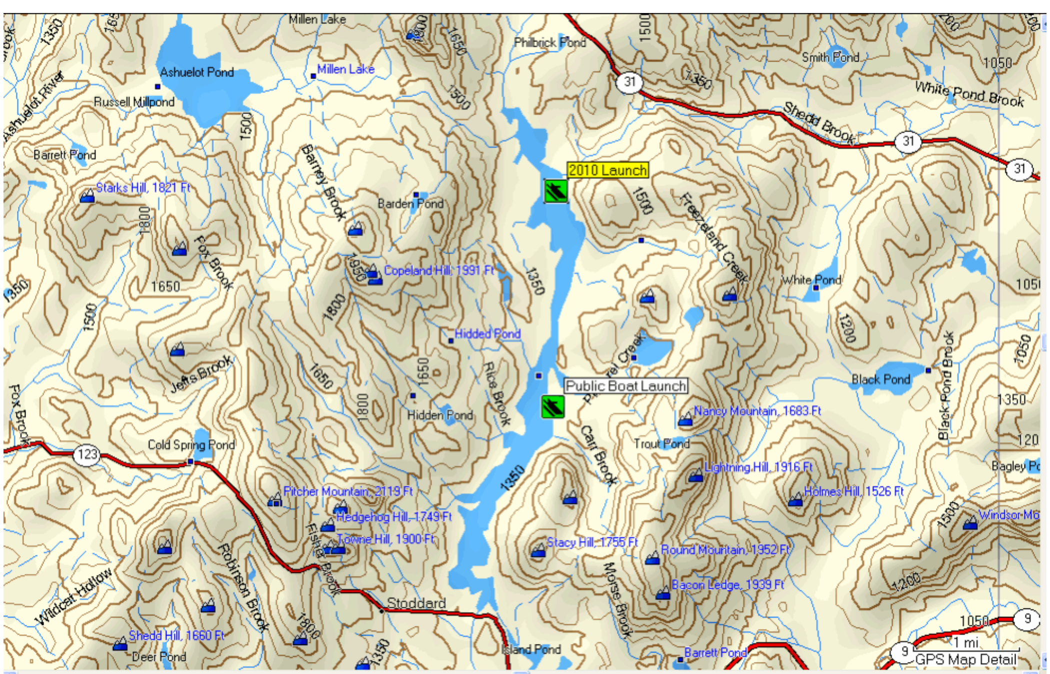
Site access

From Concord, Interstate 89 — 43 min, 24.5 mi

Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W/U.S. 202 W; Continue to follow NH-9 W.
Route to public launch:

Take Rt 9, to Rt 123, to 1219 Shed Hill Rd., the Highland Lake Marina. There is not any first hand information regarding the accessibility of this launch. For more information regarding the Highland Lake Marina view their web site: highlandlakemarina.com - **END**





Washington & Stoddard,

New Hampshire

Coordinates:

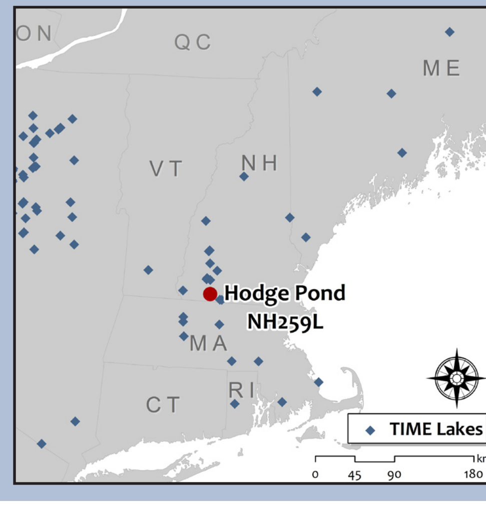
Sampling Point:
N 43.13674
W 72.08379

Launch Point:
N 43.13635
W 72.08236

Hodge Pond

Lake ID: NH259L

Other IDs/names: NHLAK700030101-06



Lake description

Hodge Pond is a fairly secluded and inaccessible pond surrounded by floating and emergent vegetation. It is listed as a public water ("Great Pond") by the New Hampshire DES.[1] The area surrounding the pond is forested and swampy and can be difficult to move through.

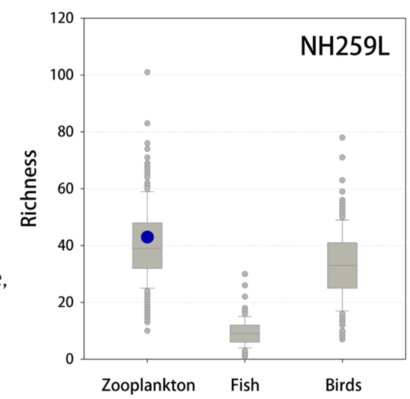
Although not much information is available about Hodge Pond, the Town of Jaffrey is active in protecting its natural and water resources. The town's Conservation Commission has worked to protect other areas in town for surface water and groundwater values. The town has a Wetlands Conservation District Ordinance and also protects areas of town that are within the viewshed of Mount Monadnock, a significant natural and recreational resource. Jaffrey's downtown is also zoned to maintain its character as a 19th Century New England "Mill Town".[2]

Using GIS data and modeling as part of its Wildlife Action Plan, the NH Fish and Game Department produced maps of significant or exemplary habitat types in 2006. Hodge Pond's west side includes one of the small (patch) scale priority habitat types, peatlands. The 10-acre mapped peatland at Hodge Pond is adjacent to a marsh-shrub wetland (Fig. NH259L.2); in combination they provide important habitat diversity. [1]

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992, 1994, and1995. Zooplankton species richness in Hodge Pond was slightly greater than the median for all EMAP lakes.[3]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[3] Individuals of the families *Corduliidae* and *Libellulidae* were collected.
Fisheries: There are no known survey data on presence or extirpation, based on state and EMAP data sources.[3]
Birds: Breeding birds were not listed in EMAP data tables.[3]

Figure NH259L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, Round Pond (blue dots).



Bathymetry

No bathymetric map is available for Hodge Pond. The depth at the 2012 sampling site was 4 m. Most of the shoreline is mixed conifer-hardwood marsh surrounding a deep peatland that extends into the pond.

Table NH259L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	22.3
Watershed area (ha)	135.0
Mean depth (m)	1.95[3]
Max depth (m)	>4
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	323
Maximum watershed elevation (m)	361
Mean watershed slope (degrees)	3.6
Landcover (% of total watershed)	
Open water	4.9
Developed, open space and low-intensity (<50% impervious)	2.1
Deciduous forest	20.0
Evergreen forest	21.9
Mixed forest	36.7
Shrub & Herbaceous	0.7
Agriculture (hay, cultivated)	3.9
Wetlands	2.4
Mean Impervious surface (% of total watershed)	0.2
Bedrock Geology	
Devonian and Silurian eugeosynclinal	

Table NH259L.2. Long-term chemistry for Hodge Pond, 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.62	0.20	12
ClpH	pH units	5.81	0.24	12
ANC	$\mu eq \cdot L^{-1}$	48.3	12.4	12
DOC	$mg \cdot L^{-1}$	7.65	1.20	12
Cond	$\mu S \cdot cm^{-1}$	26.8	6.0	12
Color*	Pt-Co units	55|51	13|18	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	67.57	9.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	30.6	2.7	12
K^{+}	$\mu eq \cdot L^{-1}$	9.8	2.6	12
Na^{+}	$\mu eq \cdot L^{-1}$	118.6	40.0	12
Al (Total)	$\mu g \cdot L^{-1}$	61.6	20.1	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	47.1	8.6	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	98.9	46.9	12
SiO_2	$mg \cdot L^{-1}$	2.58	1.57	10
Total P	$\mu g \cdot L^{-1}$	22.5	8.5	5
Total N	$\mu g \cdot L^{-1}$	376	150	9

* Color is displayed as True|Apparent

Site disturbance & considerations

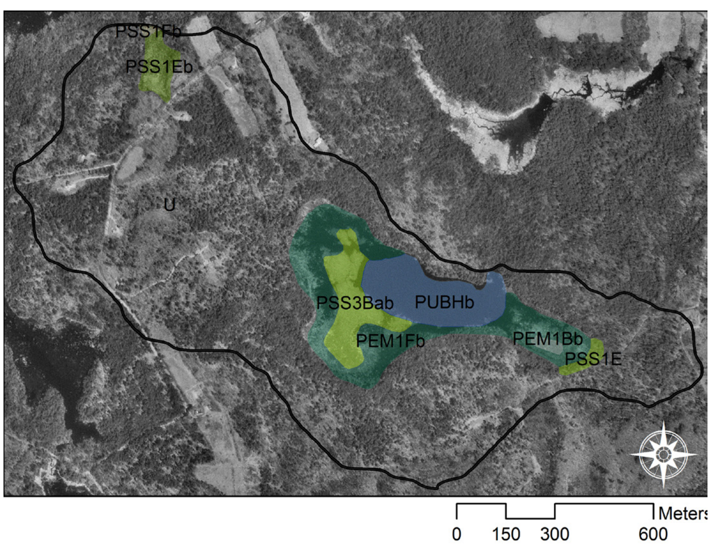
- Use a GPS unit to locate trail and launch point.
- Be aware of wet trail conditions.
- Be aware of emergent/ floating vegetation around pond and deceptively deep water.

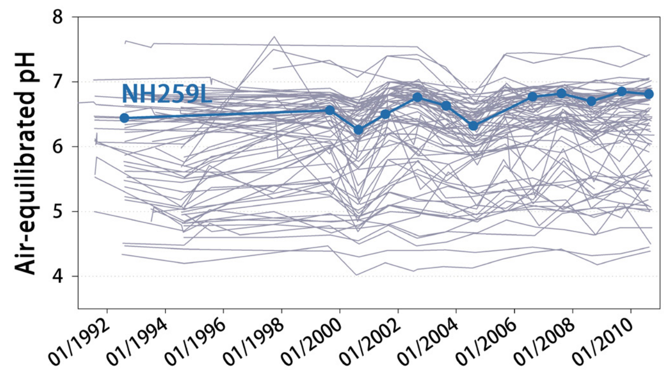
Sampling history and other studies at this lake

Very few data from other studies have been collected at Hodge Pond. It was not cored in the 1991–1995 EMAP sediment survey.[3]

As are other New Hampshire lakes, Hodge Pond (EPA ID NHLAK700030101-06) was listed as impaired based on fish consumption use in 2008; a TMDL is in place.[5] It was assessed and is in good condition with respect to drinking water after treatment, also in 2008.[5]

View of Mount Monadnock from Hodge Pond in 2002.
Photo: S. Nelson





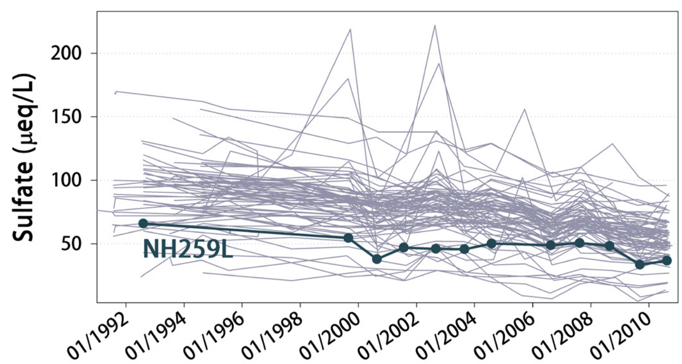


Figure NH259L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Hodge Pond, (thick blue line) has had relatively high pH, particularly given its wetland/peatland character and DOC averaging 7.65 mg/L. Hodge Pond has had among the lowest sulfate measurements in the TIME dataset.

Figure NH259L.2. NWI wetlands within the watershed of Hodge Pond (watershed delineation in black outline). Data courtesy NH GRANIT. Orthophoto date: 1998.

References

[1] Kane and Ingraham, 2009.

[2] Finn, 2008.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] US EPA, 2013.

Site access

From Manchester, NH-101

1 hr 20 min, 47 mi

NH-101 W from Manchester - **~32.3 mi**
Turn left at U.S. 202 W - **6.2 mi**
Turn right at U.S. 202 E - **377 ft**
Turn left at U.S. 202 W - **0.4 mi**
Turn right at Gilmore Pond Rd - **1.7 mi**
Turn left at Peabody Hill Rd - **0.3 mi**
Take the 2nd right onto Chadwick Rd - **0.2 mi**
Park on logging path to the right, just before Chadwick Rd opens up to a driveway and house (If 4WD capable, drive down trail to Hodge Pond) - **END**

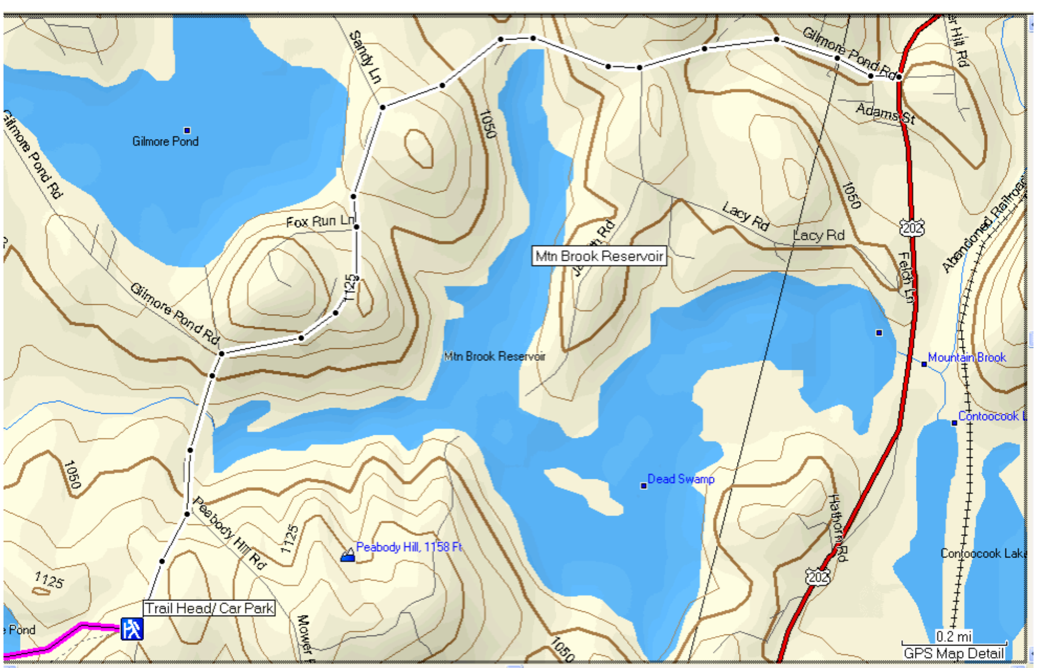

End of Chadwick Rd with logging path to the right


Stone wall leading to launch site


Looking down logging path with trail/parking and stone wall on right

Launch Site Description

With a 4WD vehicle you should be able to drive down the narrow logging path from Chadwick Rd. to the pond. Depending on the trail conditions (i.e. mud), you may have to hike the logging path. At about 0.3 miles down the trail you will see the pond and a stone wall on the right. Park next to the stone wall on the trail to the right. Follow the stone wall up the logging path about 50ft then follow an adjoined, perpendicular stone wall leading northwest to the launch site. *Do not follow the trail to the pond; it will lead you through a deep floating bog. Be prepared to bushwhack though the forest when locating the launch site because there is not a trail leading to the pond. Once at the launch site, be aware that the emergent/floating vegetation is difficult to paddle through and in water between one and three feet deep. Because there is not a trail directly to the pond and the the pond is surrounded by a floating bog, sampling can be difficult.



Jaffrey,

New Hampshire

Coordinates:

Sampling Point:
N 42.79687
W 72.06628

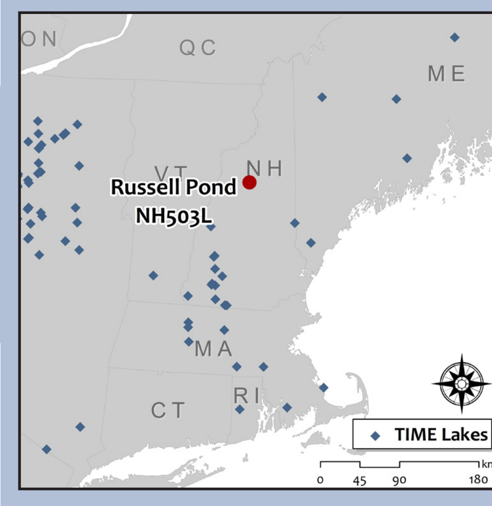
Launch Point:
N 42.79606
W 72.06656

Start of logging path:
N 42.79525
W 72.05765

Russell Pond

Lake ID: NH503L

Other IDs/names: NHLAK700010203-02



Lake description

This 40 acre mountain pond is in the Russell Pond Campground. The seasonal campground has 86 units and during summer months will see consistent use from the public. Because the NH Fish and Game Dept. regularly stocks Russell Pond, it offers good fishing opportunities. Bathroom facilities are located near the parking lot. A limnological study of Russell Pond in 1998 found that the campground did not appear to be adversely affecting the pond.[1]

Russell is one of the 'cleanest and clearest' lakes in New Hampshire.[1] It is oligotrophic, with reported Secchi depths of 12 meters. Located within Russell Pond Recreation Area and managed by the USDA Forest Service, Russel Pond's watershed is forested, conserved land.

Biota

Zooplankton: Sampled in 1993, EMAP species richness in Russell Pond was near the 25th percentile for all EMAP lakes.[2] A 1998 study collected and identified zooplankton to the genus level; Calanoid copepods were 87.5% of crustacean zooplankton in Russell Pond.[1]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[3] Individuals of the families *Aeshnidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: Brook Trout are the only species listed by NH Fish and Game.[4] Only brook trout and golden shiner were listed in EMAP data from 1993 sampling.[2]

Birds: Breeding birds species richness was also low in the comparison to the EMAP 1993 dataset.[2]

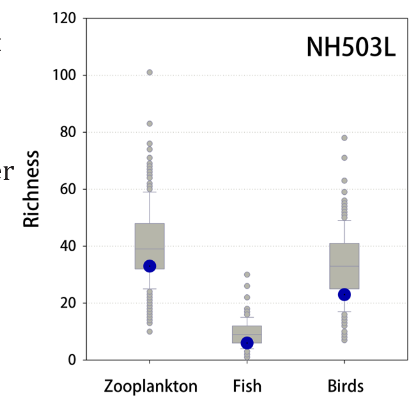
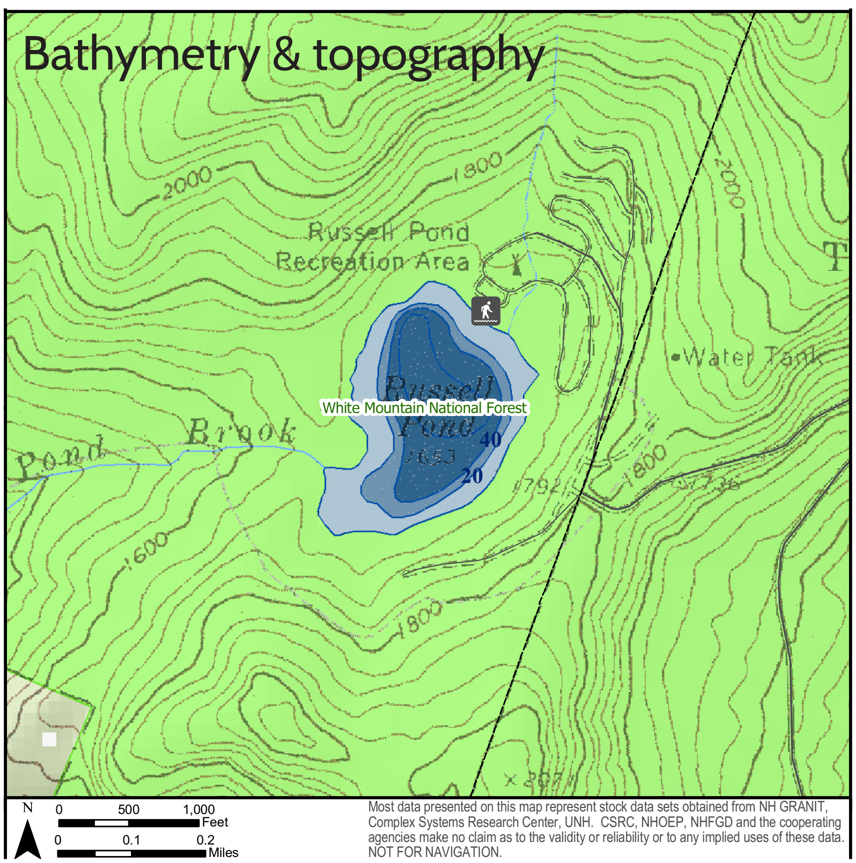


Figure NH503L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[2] (gray box plot) and for this lake, Russell Pond (blue dots).

Bathymetry & topography



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

FISHERY: Coldwater	ACRES: 41
TROPHIC LEVEL: OLIGO	
AVG DEPTH: 33	MAX DEPTH: 74
SPECIES: EBT	
ADDITIONAL INFO:	
ACCESS: Russell Pond campground, beach	

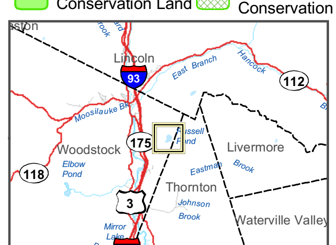
Contact NH Dept of Safety, Marine Patrol Bureau for information regarding waterbody restrictions (603) 293-0091

Public Water Access site (State, Federal, or Road-to-Public-Water)
- Canoe/cartop
- Shorebank
- Ramp
- Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation Land
- Restricted Access Conservation
- Cleared
- Forest
- Contour
- Building

Source: USGS



Directions: Tripoli Rd (WMNF)

Table NH503L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	16.3
Watershed area (ha)	157.7
Mean depth (m)	10.1[6]
Max depth (m)	22.6[6]
Drainage class	drainage
Number of inlets	1
Number of outlets	1
Flow alteration	beaver dam, 1998[1]
Topography	
Minimum watershed elevation (m)	503
Maximum watershed elevation (m)	747
Mean watershed slope (degrees)	13.0
Landcover (% of total watershed)	
Open water	7.9
Developed, open space and low-intensity (<50% impervious)	1.7
Deciduous forest	54.3
Evergreen forest	2.6
Mixed forest	31.3
Wetlands	2.0
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Devonian eugeosynclinal	

Table NH503L.2. Long-term chemistry for Russell Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.74	0.06	12
ClpH	pH units	6.45	0.13	12
ANC	$\mu eq \cdot L^{-1}$	36.4	3.9	12
DOC	$mg \cdot L^{-1}$	1.90	0.22	12
Cond	$\mu S \cdot cm^{-1}$	17.6	1.9	12
Color*	Pt-Co units	3|5	3|5	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	75.6	5.5	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	20.6	1.9	12
K^{+}	$\mu eq \cdot L^{-1}$	9.7	1.3	12
Na^{+}	$\mu eq \cdot L^{-1}$	39.8	2.7	12
Al (Total)	$\mu g \cdot L^{-1}$	26.7	12.8	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	84.0	12.1	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	1.4	1.5	12
Cl^{-}	$\mu eq \cdot L^{-1}$	13.4	1.7	12
SiO_2	$mg \cdot L^{-1}$	2.55	0.93	10
Total P	$\mu g \cdot L^{-1}$	3.3	2.1	5
Total N	$\mu g \cdot L^{-1}$	159	48	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Upon arrival, notify the campground caretaker.
- No motor boats.

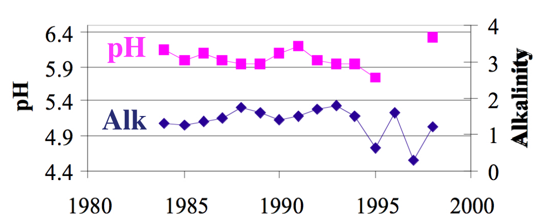


Fig. NH503L.2. Alkalinity and pH measured from 1980 to 1998 at Russell Pond (Bailey & Davignon).[1]

Sampling history and other studies at this lake

Russell Pond was cored in 1993 as part of an EMAP sediment survey that evaluated top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[2] Based on the EMAP core at Russell Pond, diatom-inferred pH was 6.97 in the bottom (pre-1850) section, and 6.74 in the top (recent) section.[2]

Russell Pond has been impaired based on the aquatic life (due to pH and, in 2006, aluminum) and fish consumption uses (due to mercury) since 2002. TMDLs are in place for both impairments.[5]

Russell Pond was studied in September, 1998 with samples for phytoplankton, zooplankton, Chloropyll-a, light attenuation, temperature, dissolved oxygen, pH, alkalinity (Fig. NH503L.2), and conductivity analyzed. The pond was stratified and had high transparency (mean=13.8±0.07 (SE) m). Nutrients (Total P= 3.8±0.24 (SE)) ppb) and productivity (Chl-a=0.5 μg/L) were low. Dissolved oxygen persisted in the hypolimnion.[1]

NH DES lists monitoring data for pH and other chemistry in Russell Pond in 1979 (pH=5.7) and 1996 (pH=6.8). Secchi depth was ~12 m in both years.[6] NH DES also monitored the outlet of Russell Pond in a study of lakes with possible acidic outlets.[6] Samples were collected once in spring (April or May) and once in fall (late October or November) of each year from 1996–2009. Spring pH was 5.8±0.28 (n=15) and fall pH was 6.0±0.19 (n=15) during the study; without details on antecedent conditions and snowmelt each year, it is difficult to assess the potential for episodic acidification but the small difference between seasons suggests limited concern.[6]

References

[1] Bailey and Davignon, 1999.

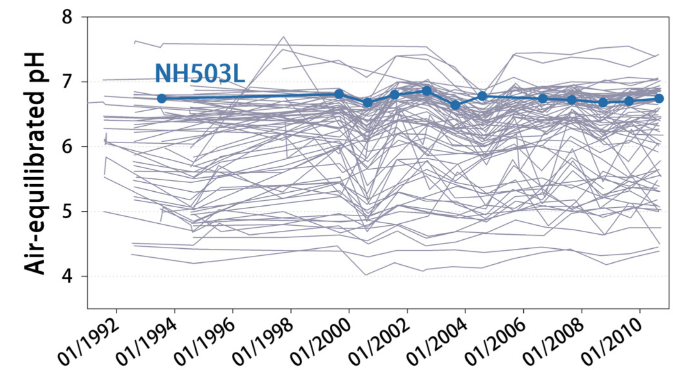
[2] US EPA, 2012.

[3] Nelson *et al.*, 2011.

[4] NH Fish and Game Department, 2009.

[5] US EPA, 2013.

[6] NH DES, 2009.



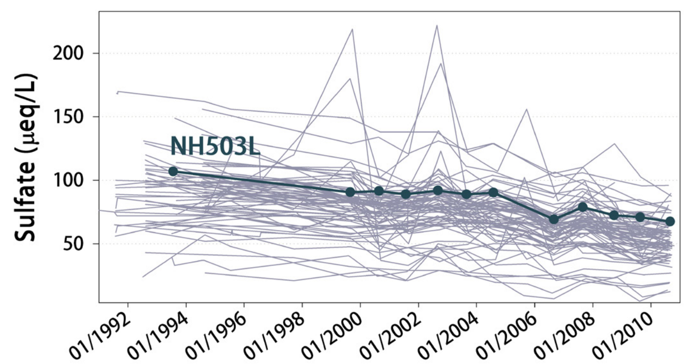


Figure NH503L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Russell Pond (thick blue line) has had pH near 6.7 and relatively high - but declining - sulfate concentrations. Sulfate could be high due to Russell Pond's high elevation.

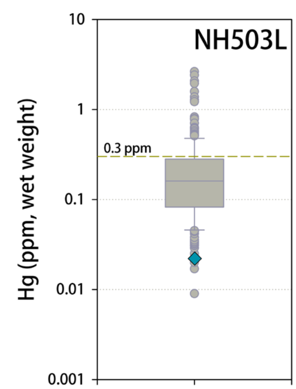


Figure NH503L.4. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[2] (gray box plot) and for this lake (blue dot), in 1993. Russell's brook trout (*Salvelinus fontinalis*) had only 0.02 ppm of Hg, but probably these fish were stocked and are an inappropriate measure for mercury in this pond. The US EPA advisory level is 0.3 ppm.

Site access

From Concord, Interstate 93 — 1 hr, 62.9 mi

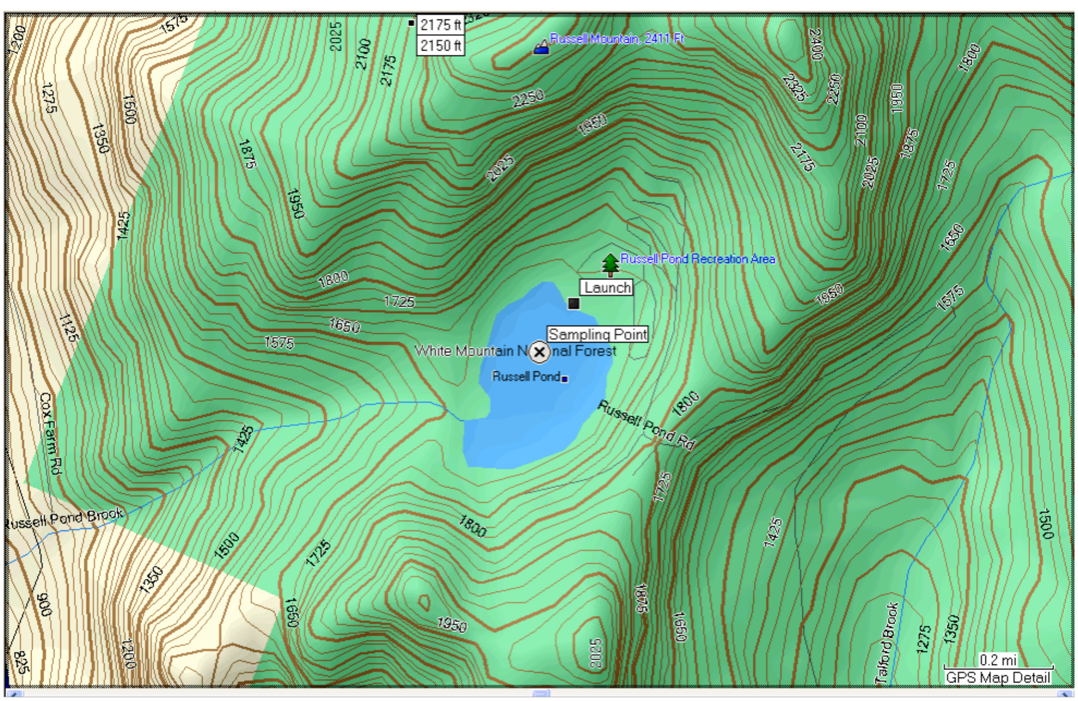
Merge onto I-93 N - **58.2 mi**
Take exit 31 for Tripoli Rd toward NH-175 - **0.3 mi**
Turn right at Tripoli Rd; (This road may be seasonally closed) - **1.9 mi**
Turn left at Russell Pond (Follow main road to Russell Pond) - **2.5 mi**
Park in the parking lot next to Russell Pond - **END**

Launch Site Description

To the south of the parking lot there are some stairs that lead down to a sandy launch point. This is an easily noticeable and accessible launch point.

Russell Pond in 2002.
Photo: S. Nelson

Russell Pond from launch site in 2002.
Photo: S. Nelson



Woodstock,

New Hampshire

Coordinates:

Sampling Point:
N 44.00973
W 71.65321

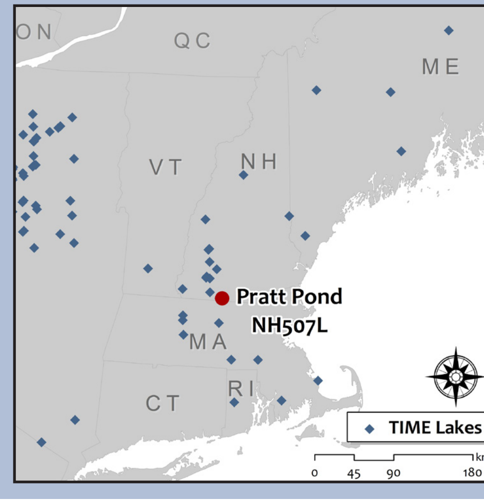
Launch Point:
N 44.01099
W 71.65196

Parking:
N 43.40090
W 70.74771

Pratt Pond

Lake ID: NH507L

Other IDs/names: NHLAK700060901-03



Lake description

Pratt Pond is a privately owned pond with a considerably high amount of residential homes along its perimeter. The pond is surrounded by access roads, many sections of which are unpaved (gravel). It has an average depth of 1.2 meters and an approximate surface area of 35 acres, and is mesotrophic.[1] There are abundant plants in the pond.

The Pratt Pond Association, formed in 1959, "maintains the private roads, dam, spillway, water quality, and represents the property owners in public matters."[2] Association founders purchased half of the pond, dam, and flow rights for $12, then drew down the pond and built a new dam. The pond is drawn down every 5 years "for permitted cleaning of beaches starting in 2005. All years in between, it will be lowered for the winter season and boards replaced by mid March, except for two top boards, which will be replaced after ice out". A Dam Committee oversees drawdowns.

According to the Association, the Pond was surveyed in 1959 for depth (at that time, maximum depth was 9 ft., average depth was 7 ft.). The water was reported as "colorless", and there a small island off founder Ed Blanchett's beach that was originally a beaver hut. The US EPA sampling team in 1993 reported that the island that did appear on their map was no longer present, and marked its location on the map as "submerged".

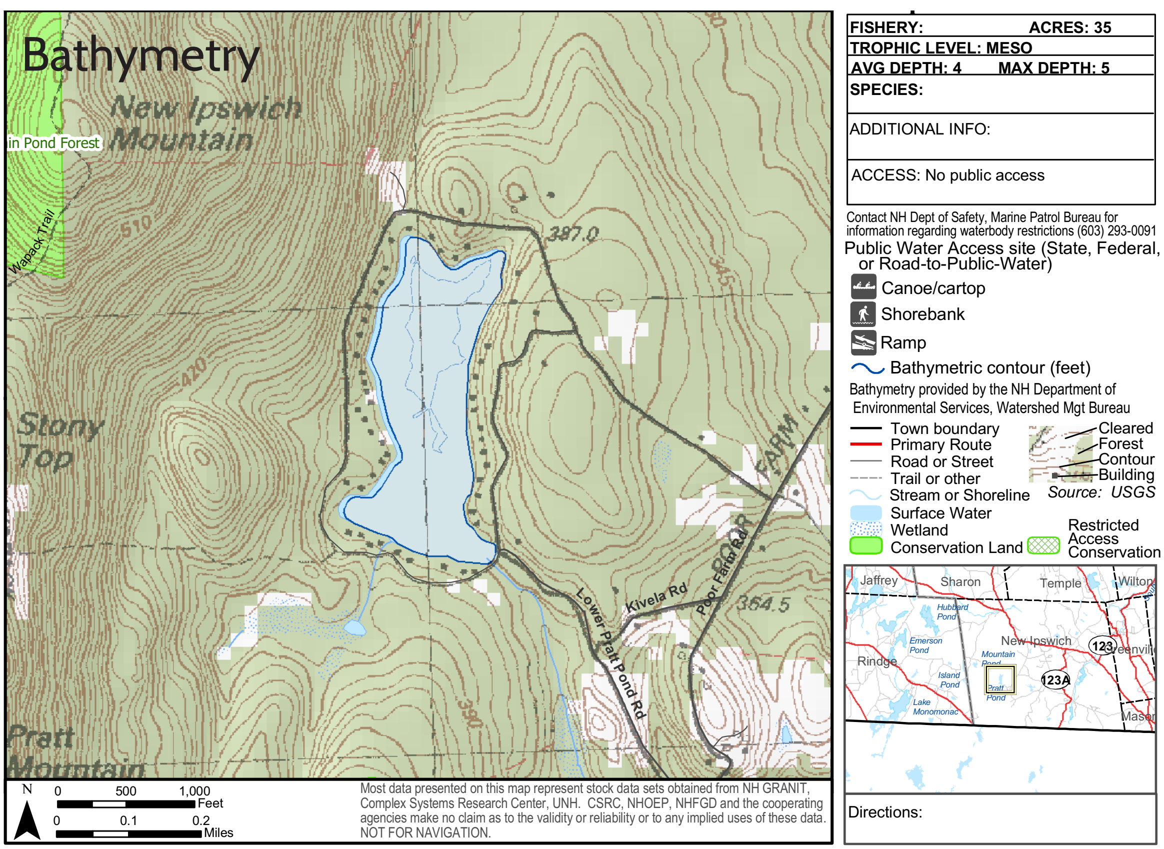
Biota

Zooplankton: Sampled in 1993 as part of EMAP, zooplankton species richness in Pratt Pond was second lowest among all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Only a few individuals of the family *Gomphidae* were collected.

Fisheries: According to the association, "The pond was stocked 3 times in the 1940's with trout that did not survive because it was too warm...The pond was reclaimed for bass in the 1960's".[2] Species richness in the 1993 EMAP survey was near the 25th percentile for all EMAP lakes.[3]

Birds: Breeding bird richness was also low in Pratt Pond, in the lowest 10% compared to all EMAP lakes.[3]



Bathymetry and topography

Table NH507L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	12.1
Watershed area (ha)	166.5
Mean depth (m)	1.2
Max depth (m)	2.7[1]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed, drawn down
Topography	
Minimum watershed elevation (m)	376
Maximum watershed elevation (m)	567
Mean watershed slope (degrees)	9.9
Landcover (% of total watershed)	
Open water	8.4
Developed, open space and low-intensity (<50% impervious)	3.9
Deciduous forest	71.2
Evergreen forest	6.7
Mixed forest	9.2
Agriculture (hay, cultivated)	0.9
Wetlands	1.6
Mean Impervious surface (% of total watershed)	0.3
Bedrock Geology (% of total watershed)	
• Devonian and Silurian eugeosynclinal (65%) • Devonian eugeosynclinal (35%)	

Table NH507L.2. Long-term chemistry for Pratt Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.37	0.20	12
ClpH	pH units	6.07	0.22	12
ANC	$\mu eq \cdot L^{-1}$	18.5	9.1	12
DOC	$mg \cdot L^{-1}$	2.50	0.50	12
Cond	$\mu S \cdot cm^{-1}$	19.3	3.1	12
Color*	Pt-Co units	6|11	1|6	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	48.2	6.1	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	21.5	3.5	12
K^{+}	$\mu eq \cdot L^{-1}$	8.3	3.0	12
Na^{+}	$\mu eq \cdot L^{-1}$	74.5	6.3	12
Al (Total)	$\mu g \cdot L^{-1}$	14.3	6.4	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	75.2	8.2	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	1.1	12
Cl^{-}	$\mu eq \cdot L^{-1}$	45.9	11.2	12
SiO_2	$mg \cdot L^{-1}$	0.89	0.72	10
Total P	$\mu g \cdot L^{-1}$	6.6	3.4	5
Total N	$\mu g \cdot L^{-1}$	182	61	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Expect to talk with local residents about project and ask permission of the resident whose property you launch from. In 2003, the Association was confrontational about outsiders sampling the pond.
- Some years locals have insisted that sampling crews use a local propery owner's boat (occasionally, a foot-paddle boat); the pond is small so any type of boat is suitable. Gas-powered boats are not allowed.
- Some properties have no buffers and lawns run directly into the pond.

Sampling history and other studies

Pratt Pond was cored in 1993 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Pratt Pond, diatom-inferred pH was 5.71 in the bottom (post-1850) section, and 5.69 in the top (recent) section.[3]

Pratt Pond was under consideration or was used as a water supply for the Greenville, NH area, and was sampled in 1913–1914 to determine its suitability for use. Although some of the chemistry data may be suspect due to instrumentation at the time, the report notes that the pond did not have any dwellings or agriculture in the watershed, and a mill had already been abandoned on the outlet.[5]

Pratt Pond is sampled as part of the NH VLAP program. In 2011, the New Hampshire Volunteer Lake Assessment Program's trend assessment reported degrading trends for Chlorophyll-a and transparency, and variable trend for epilimnetic phosphorus for Pratt Pond.[y] Average transparency in Pratt Pond (2.5 m) Lake was less than the NH median (3.2 m).[6] Pratt Pond was the most acidic in its region with a pH of 6.05, and also had the lowest conductivity (15.9 μMhos/cm).[6] Pratt's outlet was sampled once as part of the acid outlets study, in May of 2004.[1] At that time, its pH was 5.43 and color was 15,[1] somewhat elevated compared to TIME summer samples and suggesting elevated organic acidity as a mechanism for spring epsiodic acidification.

Pratt is listed as impaired for mercury and pH in US EPA's 303d list.[7]

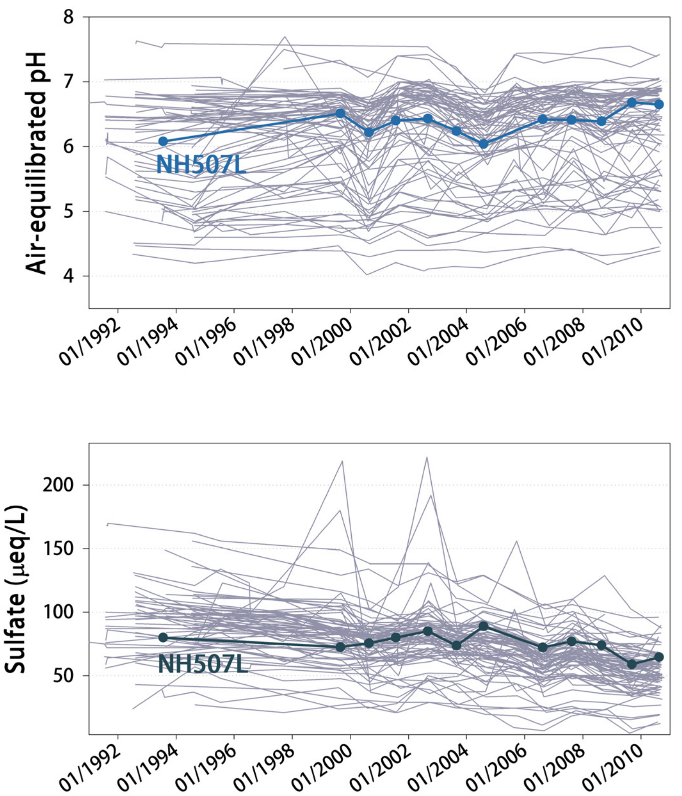


Figure NH507L.2. 1992-2011 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Round Pond, ME276L (thick blue line) has had among the lowest pH and lowest sulfate measurements in the TIME dataset. Because of its bog-like setting, the pond is probably naturally acidic.

Figure NH507L.1. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot), in 1993. Pratt's chain pickerel (*Esox niger*) had 0.285 ppm of Hg, approaching the US EPA advisory level of 0.3 ppm.

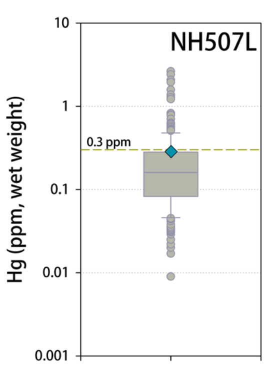


Figure NH507L.3. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, Pratt Pond (blue dots).

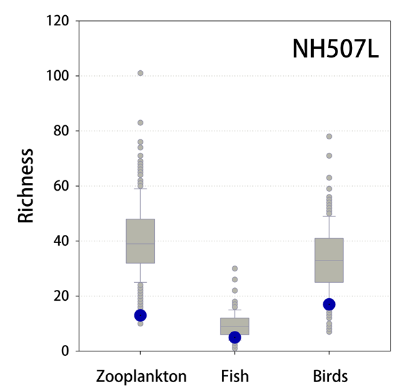


Photo date: August, 2012. Credit: A. Baumann

References

[1] NH DES, 2009.

[2] Pratt Pond Association, avaialble: http://www.prattpond-nh.org

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] State Board of Health of the State of New Hampshire, 1914.

[6] Steiner, 2012c.

[7] US EPA, 2013.

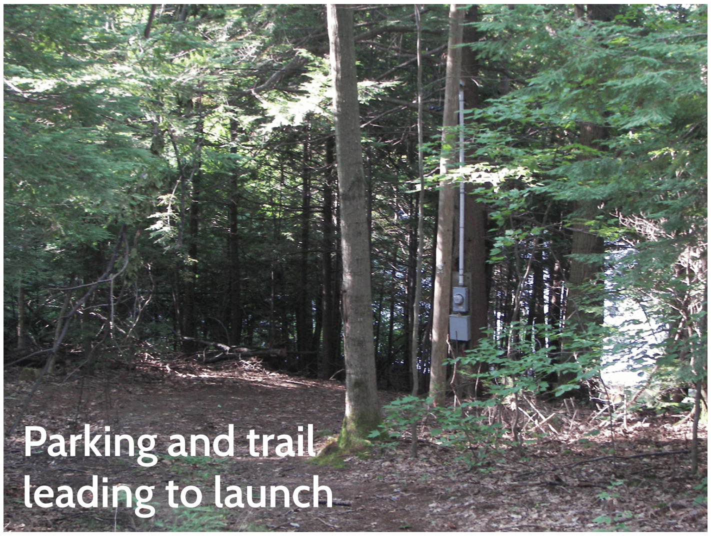
Site access

From Manchester, NH-101 1 hr, 36.7 mi

Follow NH-101 W - **23.8 mi**
Turn left at NH-31 S/Greenville Rd - **115 ft**
Turn right at NH-31 S - **4.3 mi**
Turn right at Old Wilton Rd/Wilton Rd - **0.7 mi**
Continue onto Main St - **0.3 mi**
Turn right at NH-123 N/River St.; Continue to follow NH-123 N- **1.6 mi**
Turn right at NH-123 N/NH-124 W/Turnpike Rd - **3.2 mi**
Turn left at N Rd - **0.7 mi**
Continue onto Poor Farm Rd/Poor Farm Hill Rd.; Continue to follow Poor Farm Rd - **1.2 mi**
Turn right at Upper Pratt Pond Rd - **0.6 mi - END**

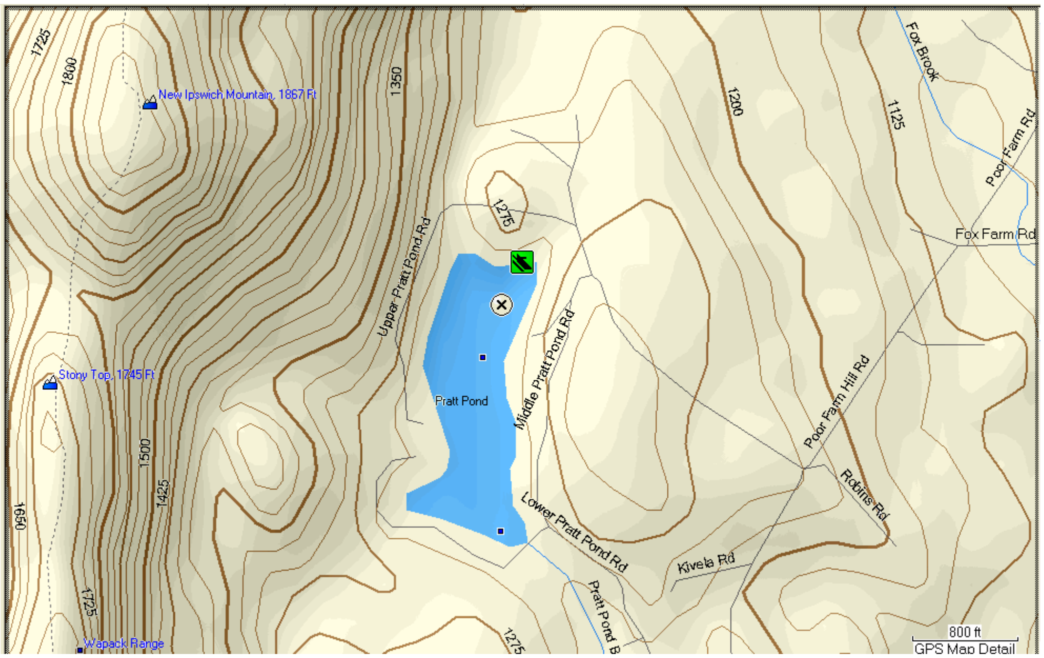
Launch Site Description

After driving 0.6 miles on Upper Pratt Pond Rd, park in a small trail inlet on the left side of the road. This lightly used trail leads down to the edge of Pratt Pond and allows for suitable access into the water. Be aware that this is not a public access point.



Parking and trail leading to launch

Launch



New Ipswich,

New Hampshire

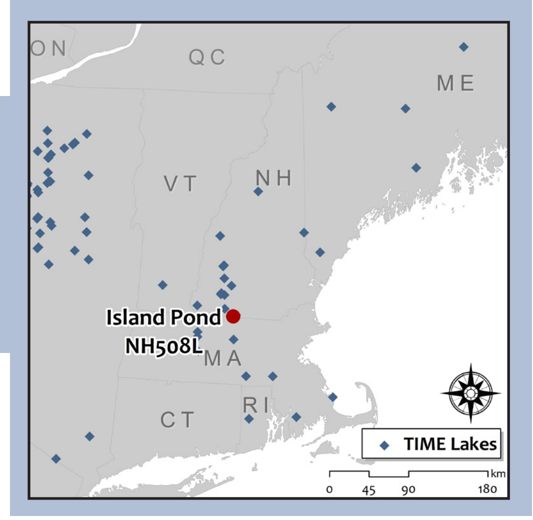
Coordinates:

Sampling Point:
N 42.74144
W 71.90615

Launch Point:
N 42.74268
W 71.90518

Island Pond

Lake ID: NH508L
Other IDs/names: NHLAK802020103-05



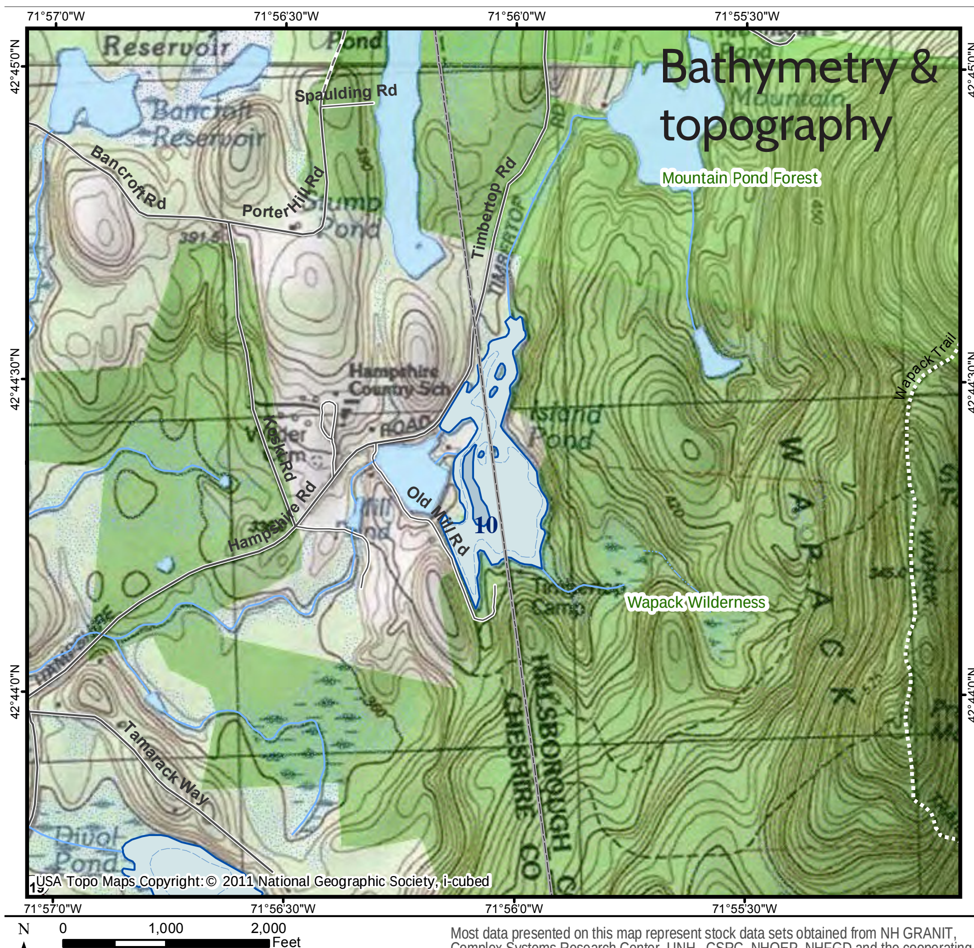
Lake description

Island Pond is mesotrophic with an average depth of 5 meters and approximate surface area of 32 acres.[1] Mostly forest surrounds the pond and there is no public access.

Along the west side of the pond is an earthen dam. In 2005 the pond was noted as infested with Eurasian water milfoil, but no signage currently appears and the pond is not on the NH list of infested ponds. It was listed as having very abundant macrophytes in a 1982 survey.[2] There is a beach on this pond, presumably used by the school. The watershed is hilly, with mixed forests and somewhat discontinuous canopy, particularly near the shore.

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1993. Zooplankton species richness in Pratt Pond was in the lowest 25 percent of all all EMAP lakes.[3] Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Gomphidae*, *Corduliidae*, and *Libellulidae* were collected. Fisheries: New Hampshire Fish and Game lists four species of fish in Island Pond,[1] similar to species richness measured during the 1993 EMAP survey (six species).[3] Birds: Breeding birds species richness was low (near the 25th percentile) compared to all EMAP lakes.[3] Snapping turtles were observed in 2011, including a hatch event.



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

FISHERY: Warmwater **ACRES: 32**
TROPHIC LEVEL: MESO
AVG. DEPTH: 5 **MAX. DEPTH: 13**
SPECIES: CWS,ECP,GS,LMB

ADDITIONAL INFO:

ACCESS: No public access

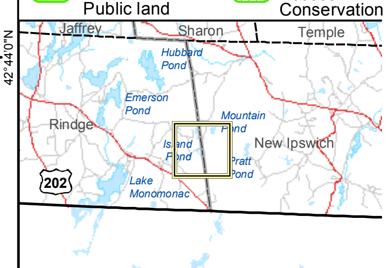
Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nhmarinepatrol.com

Public Water Access site
- Canoe/cartop
- Shorebank
- Ramp
- Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Restricted Access Conservation
- Cleared
- Forest
- Contour
- Building

Source: USGS



Directions:

Table NH508L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	11.5
Watershed area (ha)	602.3
Mean depth (m)	1.5[2]
Max depth (m)	4.5[2]
Drainage class	reservoir
Number of inlets	2
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	366
Maximum watershed elevation (m)	569
Mean watershed slope (degrees)	7.3
Landcover (% of total watershed)	
Open water	3.7
Developed, open space and low-intensity (<50% impervious)	2.6
Deciduous forest	40.7
Evergreen forest	17.4
Mixed forest	27.3
Shrub & Herbaceous	1.9
Agriculture (hay, cultivated)	0.6
Wetlands	9.3
Mean Impervious surface (% of total watershed)	0.1
Bedrock Geology (% of total watershed)	
• Devonian eugeosynclinal (95%) • Devonian and Silurian eugeosynclinal (5%)	

Table NH508L.2. Long-term chemistry for Island Pond, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.41	0.11	12
ClpH	pH units	5.96	0.12	12
ANC	$\mu eq \cdot L^{-1}$	26.6	6.4	12
DOC	$mg \cdot L^{-1}$	4.55	0.71	12
Cond	$\mu S \cdot cm^{-1}$	20.5	1.8	12
Color*	Pt-Co units	27|27	6|7	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	59.4	4.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	21.9	1.7	12
K^{+}	$\mu eq \cdot L^{-1}$	6.1	1.9	12
Na^{+}	$\mu eq \cdot L^{-1}$	82.5	6.2	12
Al (Total)	$\mu g \cdot L^{-1}$	54.8	22.3	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	63.7	6.7	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	57.4	8.9	12
SiO_2	$mg \cdot L^{-1}$	2.17	1.70	10
Total P	$\mu g \cdot L^{-1}$	12.2	5.5	5
Total N	$\mu g \cdot L^{-1}$	279	134	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Due to the possible Euarasian Water Milfoil infestation, be sure to power wash and remove all plant material after sampling.

Island Pond in 2002. Photo: S. Nelson

Sampling history and other studies at this lake

Island Pond was cored in 1993 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Island Pond, diatom-inferred pH was 6.71 in the bottom (post-1850) section, and 5.85 in the top (recent) section.[3]

Few, if any, studies have been conducted on Island Pond. It is listed as impaired with respect to mercury in the US EPA Waters, and was assessed as "good" with respect to drinking water (post treatment) in 2006.[5] It was sampled in 1982 as part of a state survey, in which pH was 5.4, Secchi depth was 2.3 m, and Chlorophyll-a was 3.16 µg/L.[2] Although low, the measured pH agrees somewhat with EMAP's recent core. Depending on methodology used in the 1982 survey, pH could have been depressed due to biological activity, if it was not air-equilibrated in the laboratory.

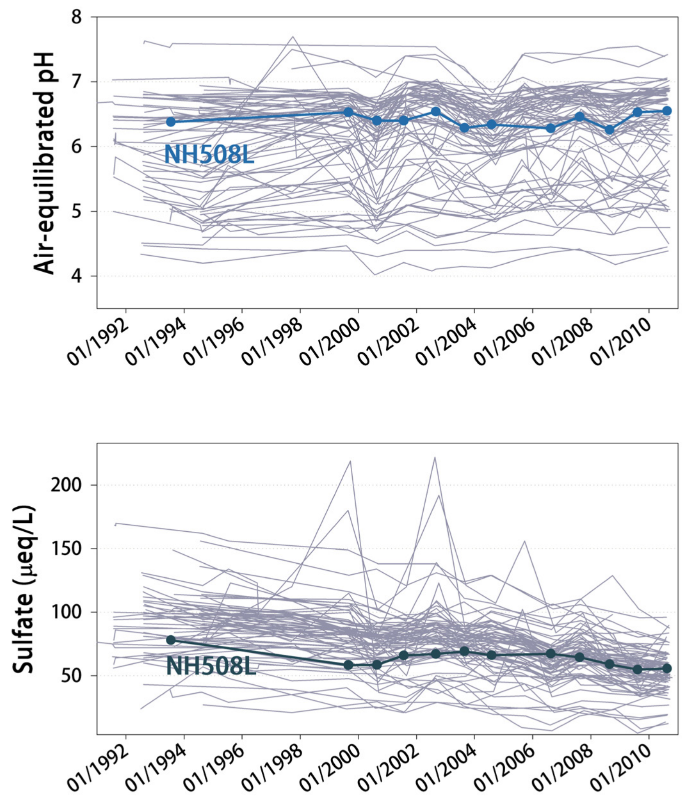


Figure NH508L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Island Pond (thick blue line) has had moderate pH throughout the period of record, with little variablility or dirtectional change. Sulfate has also been moderate, again without large directional change.

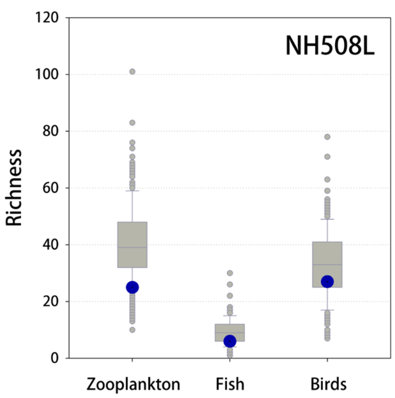
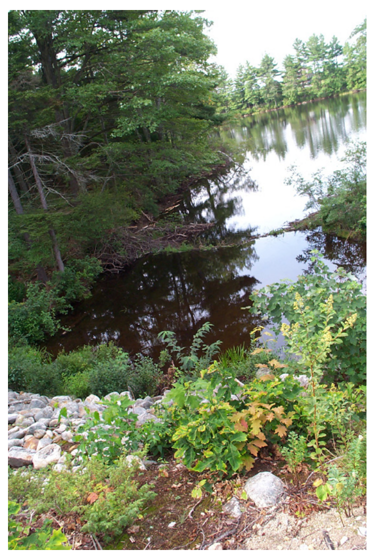


Figure NH508L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this pond (blue dots).



Island Pond from the dam in 2002. Photo: S. Nelson

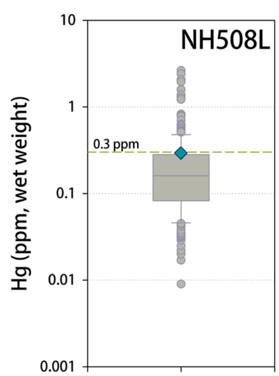


Figure NH508L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot), in 1993. Island Pond's chain pickerel (*Esox niger*) had 0.293 ppm of Hg, approaching the US EPA advisory level of 0.3 ppm.

References

[1] NH Fish and Game Department, 2009.

[2] NH DES, 2009.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] US EPA, 2013.

Photo date: August, 2012 • Credit: A. Baumann

Site access

From Manchester, NH-101 — 1hr 10 min, 39.3 mi

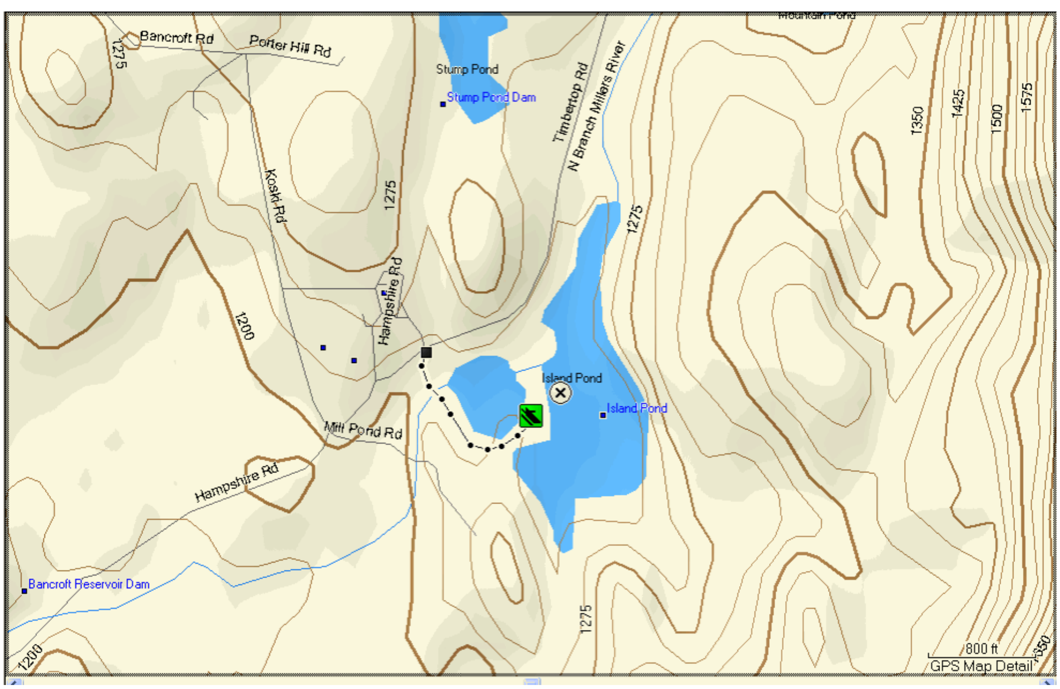
Follow NH-101 W - **23.8 mi**
Turn left at NH-31 S/Greenville Rd - **115 ft**
Turn right at NH-31 S - **4.3 mi**
Turn right at Old Wilton Rd/Wilton Rd - **0.7 mi**
Continue onto Main St - **0.3 mi**
Turn right at NH-123 N/River St.; Continue to follow NH-123 N - **1.6 mi**
Turn right at NH-123 N/NH-124 W/Turnpike Rd - **5.1 mi**
Turn left at Timbertop Rd - **3.5 mi**
Turn left at wooden bridge (before road turns to dirt)
Take left at fork and follow dirt road to Hampshire Country School Beach - **END**

Launch Site Description

The best access to Island Pond is at the Hampshire Country School Beach on the west side of the pond.

Wooden bridge and road leading to Hampshire Country School Beach

Looking north toward Timbertop Rd from Launch Site

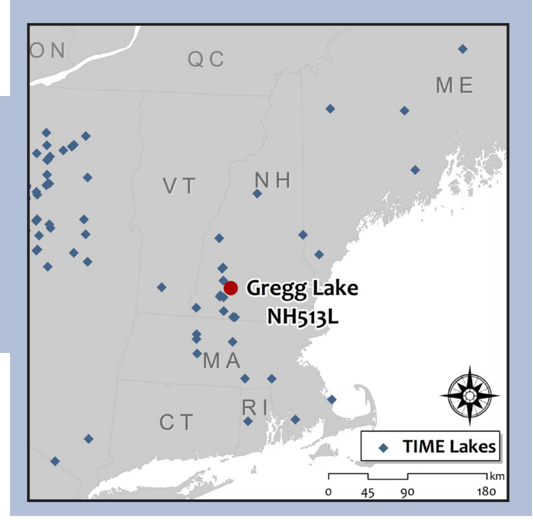


New Ipswich, New Hampshire

Coordinates:

Sampling Point:
N 42.73916
W 71.93456

Launch Point:
N 42.73867
W 71.93539



Gregg Lake

Lake ID: NH513L

Other IDs/names: NHLAK700030108-02-01

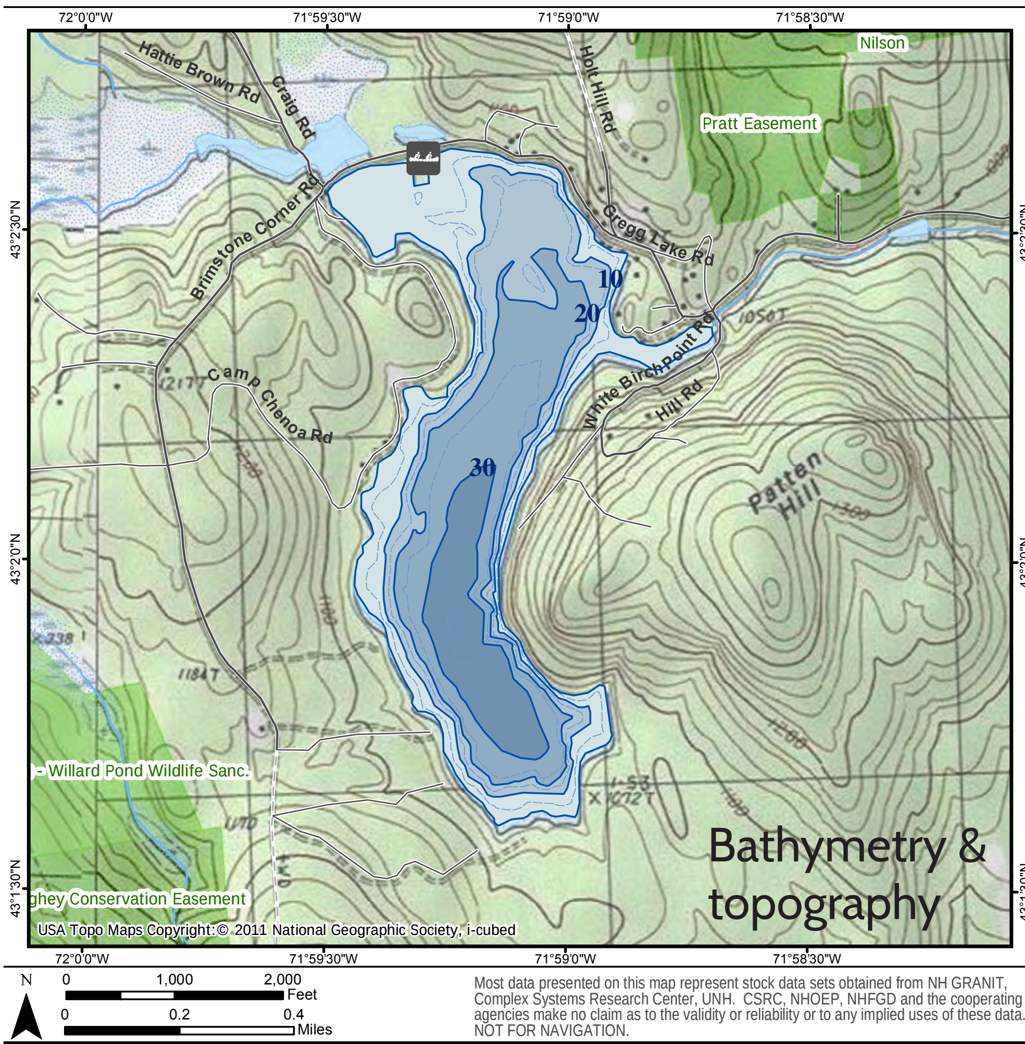
Lake description

Gregg Lake, a warmwater fishery with oligotrophic conditions, has a considerable amount of recreational activity including swimming at a lifeguarded beach, fishing, picnicking, water skiing, boating, sailing and bird watching. At approximately 201 acres in area, and 5.3 m in average depth it is relatively large compared to most other TIME lakes.[1] Although forest surrounds most of the lake, residential housing is present along the shores, especially along Gregg Lake Road, the northern shore.

There is apparently a Gregg Lake Association, in existence since the 1960s, but information was limited to meeting minutes on the Town of Antrim's web site.[2]

The Town of Antrim is heavily wooded and ~70% of the town is in rural or rural conservation zoning disctricts. There is a short trail (Meadow Marsh trail, ~0.5 miles) on Town property along the wetland areas at the north end of Gregg Lake on either side of Craig Road.[2]

Gregg Lake Dam, on Great Brook on the east side of the lake, is a municipal dam that impounds the lake for recreational use.[3] A Girl Scout Camp is located on the west side of the lake; *E. coli* and fecal coliform have been measured there and at the town beach but no exceedances appear in the EPA STORET database.[4]



FISHERY: Warmwater	ACRES: 201
TROPHIC LEVEL: OLIGO	
AVG. DEPTH: 20	MAX. DEPTH: 35
SPECIES: SMB,LMB,RBS,BG,ECP, CSF,YP,HP	
ADDITIONAL INFO: fishing restriction; motor restriction	
ACCESS: town ramp, limited	

Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nhmarinepatrol.com

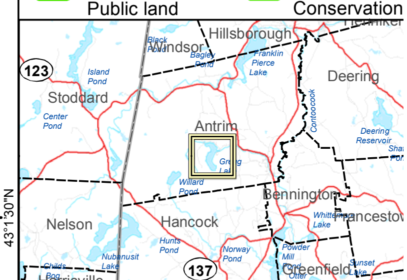
Public Water Access site

- Canoe/cartop
- Shorebank
- Ramp
- Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Restricted Access Conservation
- Cleared
- Forest
- Contour
- Building

Source: USGS



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

Directions: Rt 31 to Gregg Lake Rd, 2.5 mi on L

Table NH513L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	77.2
Watershed area (ha)	1144.6
Mean depth (m)	5.3[1]
Max depth (m)	11[1]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	320
Maximum watershed elevation (m)	583
Mean watershed slope (degrees)	6.2
Landcover (% of total watershed)	
Open water	7.5
Developed, open space and low-intensity (<50% impervious)	2.1
Deciduous forest	40.6
Evergreen forest	10.6
Mixed forest	32.7
Shrub & Herbaceous	0.8
Agriculture (hay, cultivated)	1.2
Wetlands	6.7
Mean Impervious surface (% of total watershed)	0.1
Bedrock Geology (% of total watershed)	
• Middle Paleozoic granitic rocks (99%) • Devonian and Silurian eugeosynclinal (1%)	

Table NH513L.2. Long-term chemistry for Gregg Lake, 1993-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.68	0.11	12
ClpH	pH units	6.34	0.20	12
ANC	$\mu eq \cdot L^{-1}$	38.2	5.03	12
DOC	$mg \cdot L^{-1}$	3.65	0.57	12
Cond	$\mu S \cdot cm^{-1}$	24.5	3.2	12
Color*	Pt-Co units	11|14	3|5	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	67.5	5.1	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	20.4	1.8	12
K^+	$\mu eq \cdot L^{-1}$	7.2	1.3	12
Na^+	$\mu eq \cdot L^{-1}$	113.7	15.5	12
Al (Total)	$\mu g \cdot L^{-1}$	14.6	11.3	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	62.2	9.3	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^-	$\mu eq \cdot L^{-1}$	87.5	16.0	12
SiO_2	$mg \cdot L^{-1}$	1.57	0.81	10
Total P	$\mu g \cdot L^{-1}$	6.3	2.6	5
Total N	$\mu g \cdot L^{-1}$	194	58	9

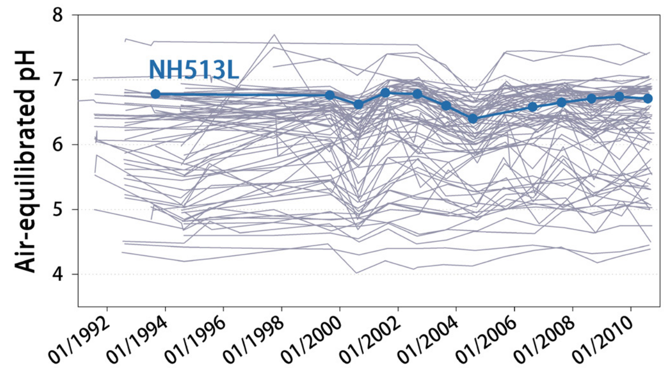
* Color is displayed as True|Apparent

Site disturbance & considerations

- Expect to encounter many people during the summer months and be aware of larger boats when sampling.
- The Gregg Lake Association apparently monitors for aquatic plants ("Weed Watch") and participates in the "Lake Host" program. The association has also done geese and fish counts.[2] Geese were often seen while sampling this lake but apparently are not affecting trophic status.

Sampling history and other studies

Gregg Lake was not cored in the 1991-1995 EMAP sediment survey. Gregg Lake was sampled by NH DES in 1978 and 1994, for basic water chemistry and water quality. pH during both sampling events was 6.5, similar to that measured in the TIME program.[1] In 2011, the New Hampshire Volunteer Lake Assessment Program reported average transparency in Gregg Lake (~3.0 m), slightly less than the NH median (3.2 m).[5] Total phosphorus (epilimnetic) was 10 µg/L, just below the New Hampshire median value of 12 µg/L. Chlorophyll-a in Gregg Lake was ~7 $\mu g/m^3$; concentrations above 5 mg/m^3 are considered undesirable.[5] Gregg Lake was assessed as “good” for primary and secondary contact, and drinking water after treatment. It is impaired with respect to mercury and pH (aquatic life).[4]



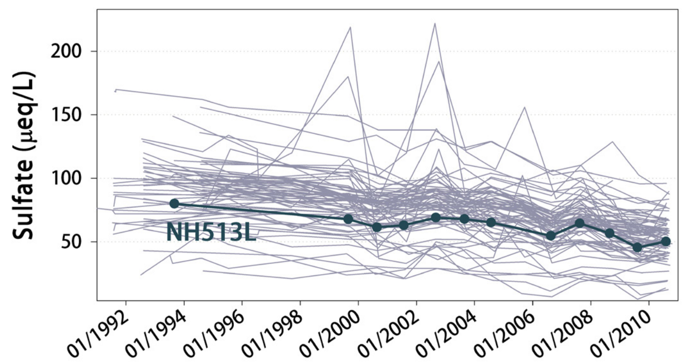
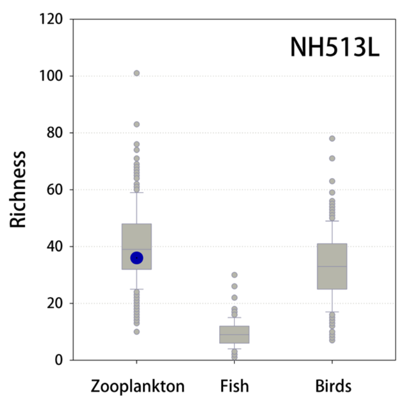


Figure NH513L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Gregg Lake (thick blue line) has had moderate and steady pH and somewhat low sulfate measurements as compared with other TIME lakes. Sulfate has steadily - though slightly - declined through the period of record.

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1993. Zooplankton species richness in Gregg Lake was slightly less than the median for all EMAP lakes.[6]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[7] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected.
Fisheries: Eight fish species are listed in NH Fish and Game’s fishing map for Gregg Lake (see map, p. 77).
Birds: Breeding birds were not listed in EMAP data.

Figure NH513L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[6] (gray box plot) and for this lake, (blue dot).



References

[1] NH DES, 2009.

[2] Town of Antrim, web site: http://www.antrimnh.org/Pages/AntrimNH_About/NaturalResources

[3] NH DES, 2013.

[4] US EPA, 2013.

[5] Steiner, 2012b.

[6] US EPA, 2012.

[7] Nelson *et al.*, 2011.


Photo date: August, 2012 • Credit: A. Baumann

Site access

From Concord, Interstate 89

45 min, 23.9 mi

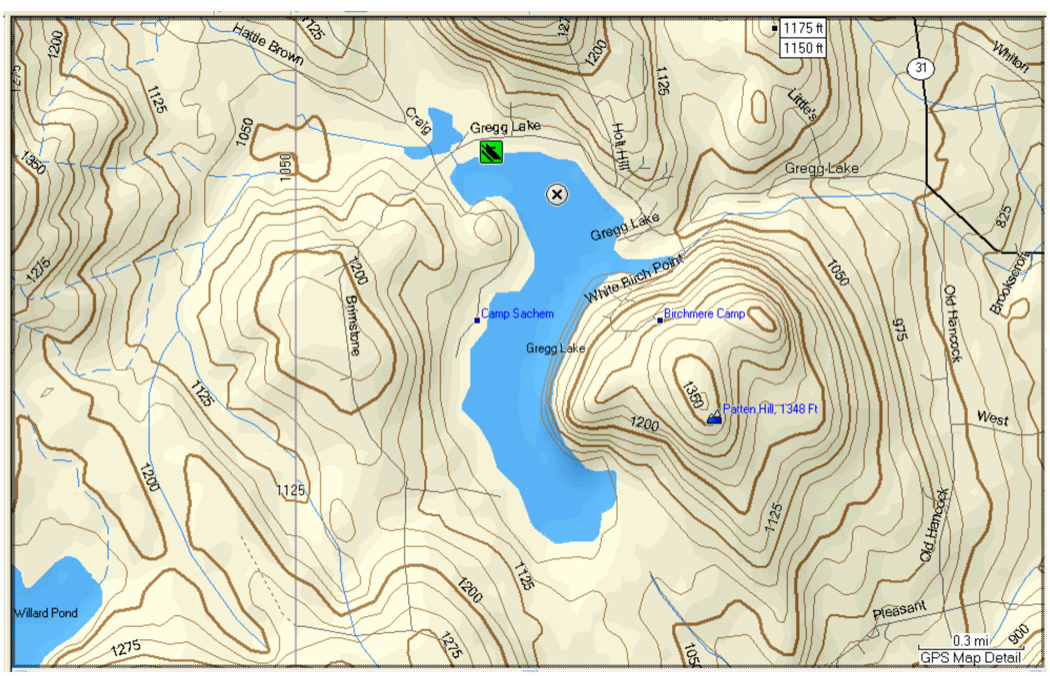
Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W/U.S. 202 W - **13.7 mi**
Merge onto U.S. 202 W via the ramp to NH-149/Peterborough - **6.5 mi**
Turn right at Elm St - **0.2 mi**
Turn right at Clinton Rd - **1.3 mi**
Slight left at Gregg Lake Rd - **1.5 mi**
Left at Antrim Town Beach - **END**

Launch Site Description

The launch area is at the Antrim Town Beach which has bathroom facilities, a public swimming area, grills, picnic tables and a recreation area. From the Antrim Town Beach parking lot, walk to the south end of the peninsula beyond the picnic tables and recreation area to edge of the water. There is a break in vegetation at the end of the peninsula where a raft can easily be launched.

Gregg Lake in 1911 from White Birch Point, Antrim, NH.
Vintage postcard courtesy S. Nelson.

Launch



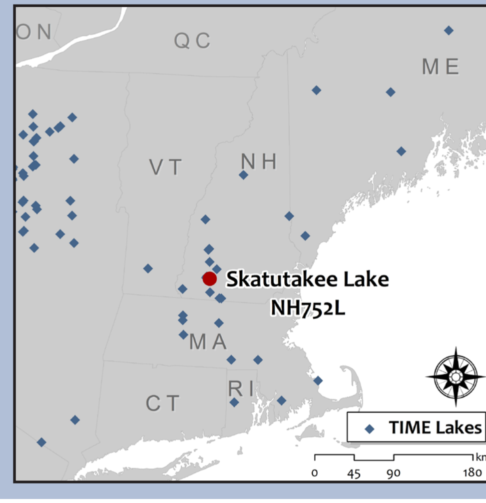
Antrim,
New Hampshire

Coordinates:
- Sampling Point:
  - N 43.04112
  - W 71.98473
- Launch Point:
  - N 43.04286
  - W 71.98844

Skatutakee Lake

Lake ID: NH752L

Other IDs/names: NHLAK700030103-08



Lake description

Skatutakee Lake is surrounded by a considerable amount of residential homes and is well used for recreational purposes. This mesotrophic lake has a surface area of approximately 191 acres and an average depth of 3 m. It is listed as a warmwater fishery.[1]

Several parcels of conserved land are within the Skatutakee watershed, but none directly border the lake shoreline. Conserved lands appear to largely be private easements or parcels, some with restricted access. There is a lake association that apparently does some volunteer monitoring as part of NH VLAP[2] and participates in programs such as Lake Host.

The lake is bisected by the dam, traversed on Hancock Road. Skatutakee Lake Dam on Nubanusit Brook is owned by the Lake Skatutakee Association; the dam's use is for recreation on the lake. At the 1994 EPA EMAP sampling, the field crew noted that "the water level had been dropped about 4 feet to inspect the dam".

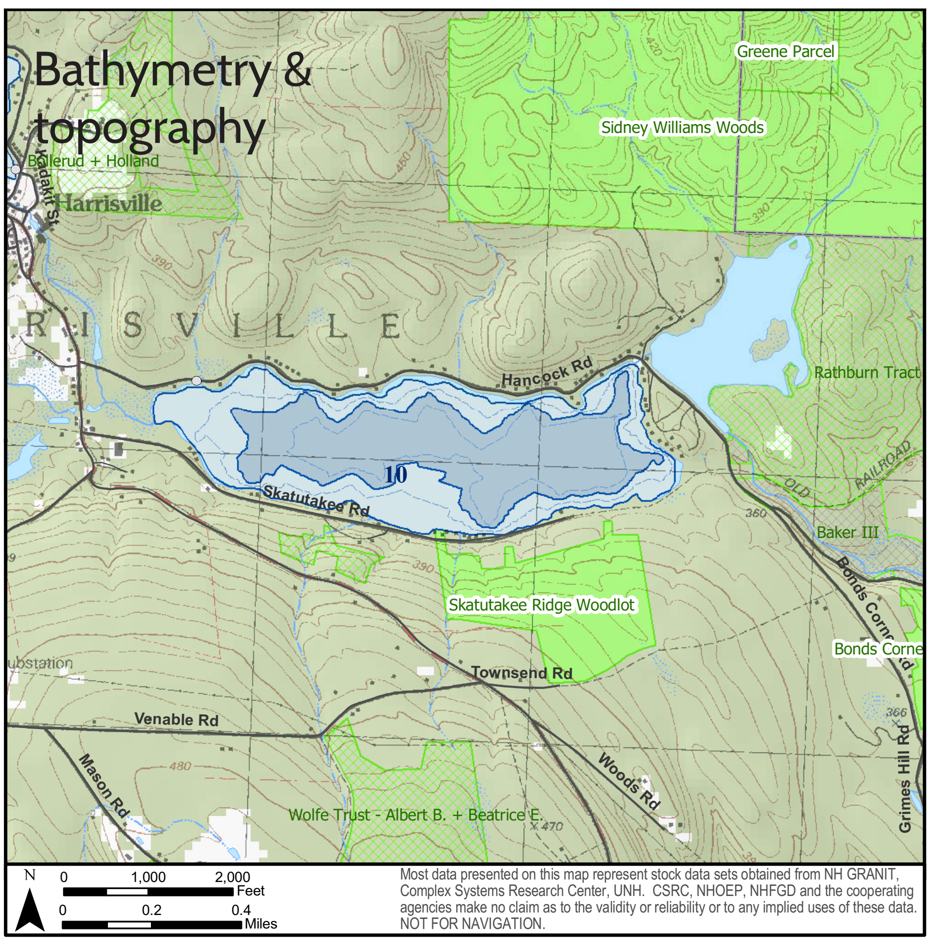
Biota

Zooplankton: In 1994, zooplankton species richness (48 species) in Skatutakee was at the 75th percentile of all EMAP lakes sampled.[3]

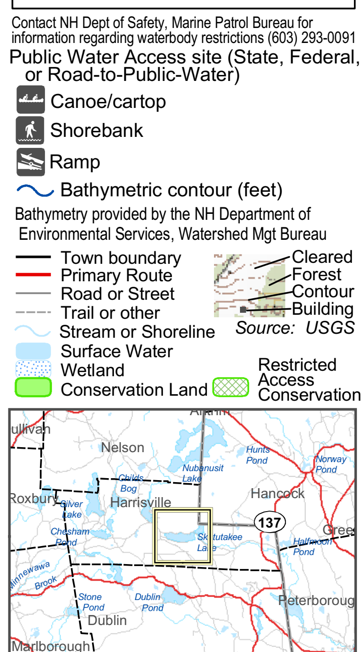
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: Six fish species are listed in NH Fish and Game data;[1] 10 fish species were listed in the EMAP survey, slightly greater than the median species richness across all EMAP lakes.[3]

Birds: Breeding bird richness (29 species) was moderate to low compared to all EMAP lakes sampled.[3]



FISHERY: Warmwater	ACRES: 191
TROPHIC LEVEL: MESO	
AVG DEPTH: 10	MAX DEPTH: 20
SPECIES: SMB,LMB,ECP,HP,NP,BC	
ADDITIONAL INFO:	
ACCESS:	



Directions: Dublin Rd to Hancock Rd

Table NH752L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	73.8
Watershed area (ha)	3549.4
Mean depth (m)	3.0[6]
Max depth (m)	6.1[6]
Drainage class	reservoir
Number of inlets	6
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	365
Maximum watershed elevation (m)	676
Mean watershed slope (degrees)	6.3
Landcover (% of total watershed)	
Open water	14.7
Developed, open space and low-intensity (<50% impervious)	2.7
Developed, medium to high density (≥50% impervious)	0.1
Deciduous forest	31.9
Evergreen forest	11.0
Mixed forest	35.4
Shrub & Herbaceous	0.1
Agriculture (hay, cultivated)	1.7
Wetlands	15.6
Mean Impervious surface (% of total watershed)	0.3
Bedrock Geology (% of total watershed)	
• Middle Paleozoic granitic rocks (63%) • Devonian and Silurian eugeosynclinal (37%)	

Table NH752L.2. Long-term chemistry for Skatutakee, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.80	0.13	12
ClpH	pH units	6.45	0.17	12
ANC	µeq • L^{-1}	46.9	4.2	12
DOC	mg • L^{-1}	2.61	0.34	12
Cond	µS • cm^{-1}	35.5	5.3	12
Color*	Pt-Co units	7|12	3|5	6|6
Ca^{2+}	µeq • L^{-1}	75.8	4.9	12
Mg^{2+}	µeq • L^{-1}	45.8	3.7	12
K^+	µeq • L^{-1}	11.9	1.8	12
Na^+	µeq • L^{-1}	163.6	25.1	12
Al (Total)	µg • L^{-1}	9.0	9.0	12
SO_4^{2-}	µeq • L^{-1}	77.7	9.0	12
NO_3^-	µeq • L^{-1}	<1.0	<1.0	12
Cl^-	µeq • L^{-1}	159.8	34.5	12
SiO_2	mg • L^{-1}	0.92	0.74	10
Total P	µg • L^{-1}	8.4	3.6	5
Total N	µg • L^{-1}	174	63	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Be aware of motor boats on the lake.
- Chloride is relatively high for an inland lake, suggesting some impact of road salt. There are some newer homes recently built on the lake.

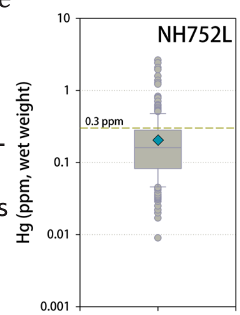


Figure NH752L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot), in 1994. Skatutakee's smallmouth bass (*Micropterus dolomieu*) had 0.204 ppm of Hg, approaching the US EPA advisory level of 0.3 ppm.

Sampling history and other studies

Skatutakee Lake was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Skatutakee Lake, diatom-inferred pH was 7.28 in the bottom (pre-1850) section, and 7.24 in the top (recent) section.[3]

Skatutakee was assessed and is impaired for Aquatic Life uses due to both pH/acidity and organic enrichment/low dissolved oxygen; it was in good condition for drinking water supply and secondary contact as of 2010.[5] As are all NH lakes, it is impaired with respect to mercury and TMDLs are in place for both pH and mercury. Dissolved oxygen has been an impairment since 2006 and pH in 2002 and 2004.[5]

Skatutakee has been sampled in NH DES surveys in 1976, 1988, and 2006. Measured pH was 6.5 and 6.63 in the latter two years, respectively, and Secchi depth ranged 2.4–3.5 m.[6]

In 2011, the New Hampshire Volunteer Lake Assessment Program's trend assessment reported a variable trend for Chlorophyll-a, with the 2011 values averaging very close to the state median of 4.58 µg/m³. Epilimnetic phosphorus had an improving trend and the 2011 value was just below the state median of 12 µg/L. Transparency had a stable trend, again just below the state median of 3.2 m.[2]

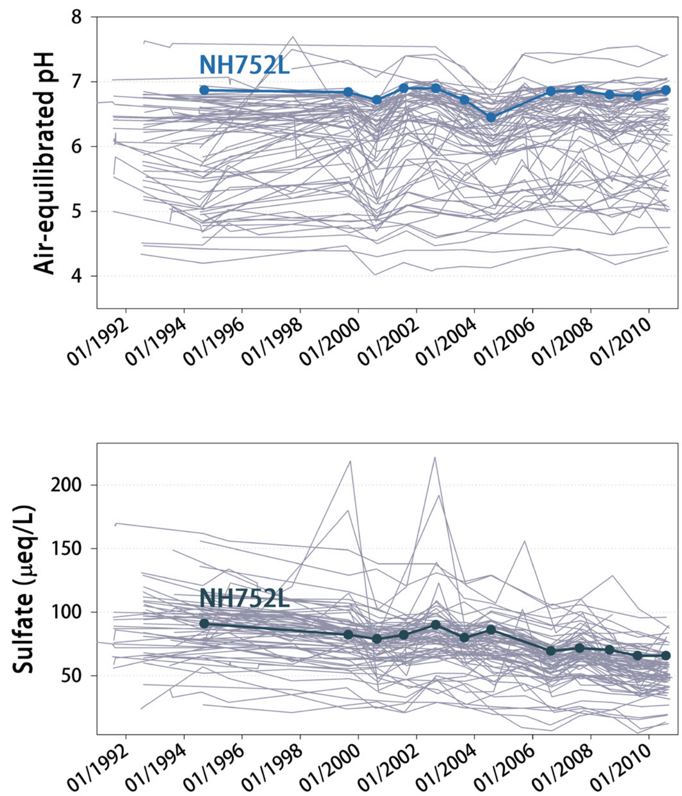


Figure NH752L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Lake Skatutakee (thick blue line) has had among the highest pH in the TIME dataset. Sulfate has been moderate to high, but has shown a slight yet steady decline over the period of record.

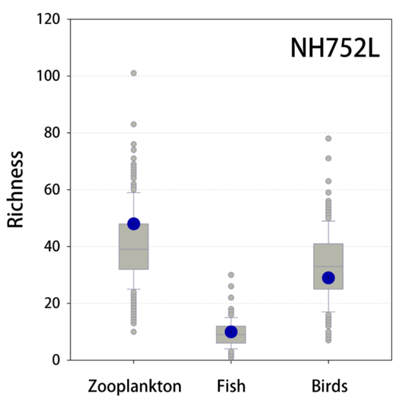
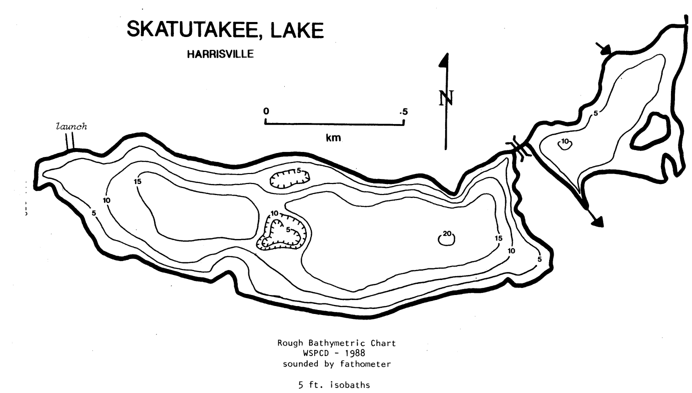


Figure NH752.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).



Older (1988) depth map for Lake Skatutakee, from NH DES.

Photo date: August, 2012 • Credit: A. Baumann

References

[1] NH Fish and Game Department, 2009.

[2] Steiner, 2012b.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] US EPA, 2013.

[6] NH DES, 2009.

Site access

From NH-101 — 3.5 mi

Turn onto Dublin Rd/New Harrisville Rd - **2.9 mi**
Turn right at Lower Main St/Main St - **0.3 mi**
Take the 3nd right onto Hancock Rd - **0.3 mi**
Public boat launch is on right - **END**

From Concord, Interstate 89 — 1 hr, 34.5 mi

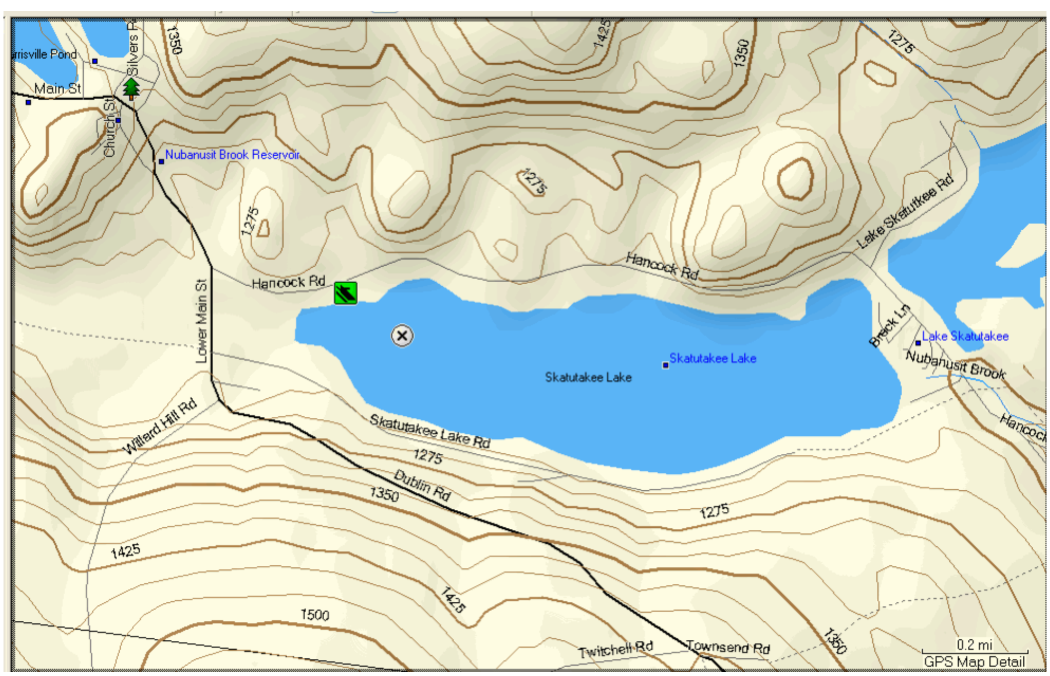
Take Exit 5, southwest toward NH-9 W/U.S. 202 W - **0.2 mi**
Merge onto NH-9 W/U.S. 202 W - **13.7 mi**
Merge onto U.S. 202 W via the ramp to NH-149/Peterborough - **6.8 mi**
Turn left to stay on U.S. 202 W - **3.3 mi**
Turn right at NH-137 S/Bennington Rd - **3.0 mi**
Turn right at NH-123 N/NH-137 S/Main St - **0.2 mi**
Slight left at NH-137 S/Hancock Rd/Old Hancock Rd
Continue to follow NH-137 S - **3.5 mi**
Turn right at Hancock Rd - **1.1 mi**
Continue straight onto Jaquith Rd - **89 ft**
Continue onto Hancock Rd - **3 mi**
Public boat launch is on left (Park on the side of Hancock Rd.) - **END**

Launch Site Description

The launch site, a small gravel down slope, approximately 30' wide and 20' long, is at the northwest corner of the lake, directly off of Hancock Rd. Park on the side of Hancock Rd, near the launch and be aware of traffic.


Launch Site in 2002


Skatutakee in 2003



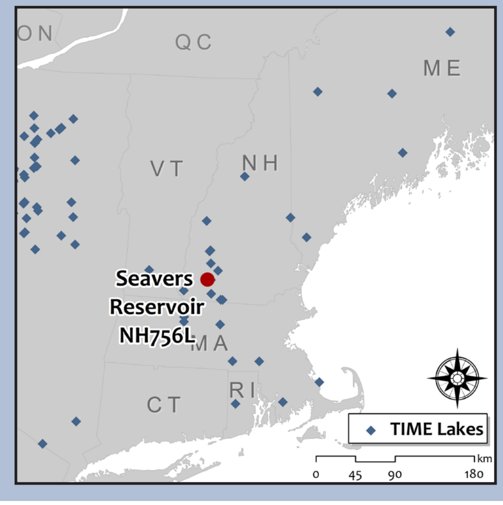
Harrisville,
New Hampshire

Coordinates:
Sampling Point:
N 42.93864
W 72.08386
Launch Point:
N 42.93981
W 72.08599

Seaver Reservoir

Lake ID: NH756L

Other IDs/names: NHLAK802010202-08; Seavers Res.



Lake description

The Seaver Reservoir is a mesotrophic lake on the Minnewawa Brook in Cheshire County, New Hampshire was dammed in 1924 and is used for recreational purposes. Its normal surface area is 39.5 acres[1] and is surrounded primarily by forested land without homes or manmade structures except for the Seaver Dam, on the western shore of the lake. It is owned by NH Water Resources Council, a state entity. Field notes from 1999 TIME fieldwork indicate that the lake was 6–10 feet drawn down at the time of sampling.

Seaver Reservoir, with other Harrisville TIME lakes Skatutakee Lake and Child's Bog and Gregg Lake in Antrim, is within a zone being called a "Supersanctuary" by the Harris Center for Conservation Education; "an aggregate of protected parcels in a 120 square mile portion of the Monadnock Region central highlands and including parts of Antrim, Greenfield, Hancock, Harrisville, Nelson, Peterborough, and Stoddard."[2] Seaver Reservoir has one 38.27 acre easement on the southern end of the pond owned by the town of Harrisville, and a second, slightly larger easement on the western shore of the lake, apparently the site of Seaver Farm, under easement as of 2010.[3]

Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1994 at Seaver Reservoir. Zooplankton species richness in Seaver Reservoir was at the 75th percentile as compared with all EMAP lakes.[4]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Aeshnidae* and *Gomphidae* were collected.
Fisheries: Five fish species were listed in EMAP data tables; this was in the lowest quartile of all EMAP lakes sampled.[4]
Birds: Breeding birds richness was low in comparison to other EMAP lakes sampled.[4]

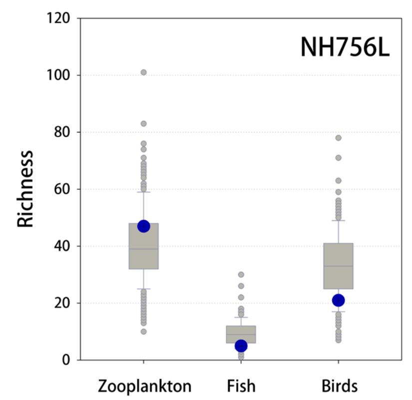


Figure NH756L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake (blue dots).

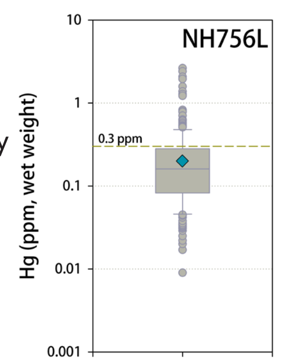


Figure NH756L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake (blue dot), sampled in 1994. Seaver Reservoir's smallmouth bass (*Micropterus dolomieu*) had 0.199 ppm of Hg, approaching the US EPA advisory level of 0.3 ppm.

Bathymetry

No bathymetric map was available for Seavers Reservoir. The dam is 28 ft high, 325 ft long, and has a 4 ft concrete spillway. It was in poor condition as of 1979.[6] The 2012 sampling site was ~7 m deep.

Table NH756L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	17.1
Watershed area (ha)	1233.0
Mean depth (m)	2.97[4]
Max depth (m)	6.1[1]
Drainage class	reservoir
Number of inlets	2
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	353
Maximum watershed elevation (m)	542
Mean watershed slope (degrees)	6.3
Landcover (% of total watershed)	
Open water	17.2
Developed, open space and low-intensity (<50% impervious)	4.1
Developed, medium to high density (≥50% impervious)	0.1
Deciduous forest	35.4
Evergreen forest	10.3
Mixed forest	30.4
Shrub & Herbaceous	0.1
Agriculture (hay, cultivated)	1.6
Wetlands	16.5
Mean Impervious surface (% of total watershed)	0.2
Bedrock Geology: Devonian & Silurian eugeosynclinal	

Table NH756L.2. Long-term chemistry for Seaver Res., 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.72	0.12	12
ClpH	pH units	6.26	0.18	12
ANC	$\mu eq \cdot L^{-1}$	35.2	6.8	12
DOC	$mg \cdot L^{-1}$	2.13	0.26	12
Cond	$\mu S \cdot cm^{-1}$	44.1	8.4	12
Color*	Pt-Co units	7|6	3|3	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	60.4	3.4	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	49.5	2.9	12
K^+	$\mu eq \cdot L^{-1}$	15.2	1.3	12
Na^+	$\mu eq \cdot L^{-1}$	233.1	46.6	12
Al (Total)	$\mu g \cdot L^{-1}$	9.4	4.4	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	87.4	7.9	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^-	$\mu eq \cdot L^{-1}$	225.8	61.0	12
SiO_2	$mg \cdot L^{-1}$	1.12	0.55	10
Total P	$\mu g \cdot L^{-1}$	6.4	3.0	5
Total N	$\mu g \cdot L^{-1}$	160	64	9

* Color is displayed as True|Apparent

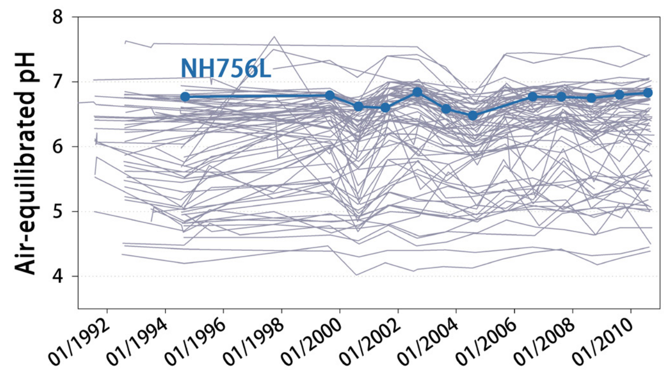
Site disturbance & considerations

- In summer months it is likely to encounter other people using this reservoir for recreational purposes.
- Though dammed and with easy road access, Seaver Reservoir has been part of a conservation project; some parcels bordering the lake are in easements.
- Field notes report dramatic increases in water level from 1999–2000.
- Road salt is likely an issue; see Na^+, Cl^- concentrations.

Sampling history and other studies

Seaver Reservoir was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[4] Based on the EMAP core at Seavers Reservoir, diatom-inferred pH was 6.84 in the bottom (post-1850) section, and 6.44 in the top (recent) section.[4]

Seaver Reservoir was sampled once in the NH DES assessment in 1990; its pH was 6.2 (similar to that measured in the TIME program), Secchi transparency was 4.8 (greater than the NH median of 3.2 for 2011), and plants were common in the lake.[1]



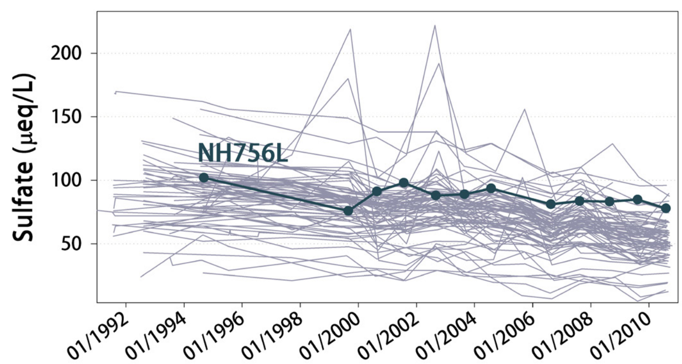
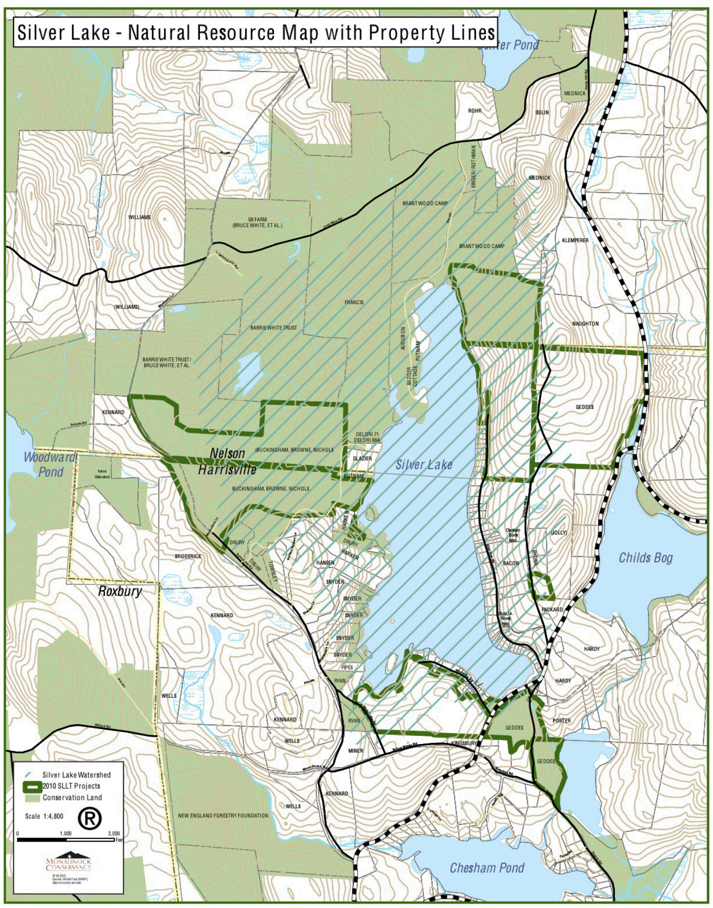


Figure NH756L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Seaver Reservoir (thick blue line) has had among the highest pH and sulfate measurements in the TIME dataset. pH has been stable; sulfate has declined slightly through the period of record.



SILVER LAKE LAND TRUST • PO BOX 222 • HARRISVILLE, NH 03458

Silver Lake Land Trust Conservation Map, 2010.[3] Seaver Reservoir is the small unnamed pond in the bottom right corner of the map. Note Childs Bog to the north of Seaver Reservoir. For a map of the larger "Supersanctuary" surrounding this land trust's focal area, see: http://slltnh.org

References

[1] NH DES, 2009.

[2] Harris Center for Conservation Education, 2013.

[3] Silver Lake Land Trust, 2010.

[4] US EPA, 2012.

[5] Nelson *et al.*, 2011.

[6] Corps of Engineers, 1979.

Site access

From Concord, Interstate 89

1 hr, 37.7 mi

Take Exit 5, southwest toward NH-9 W/U.S. 202 W - **0.2 mi**
Merge onto NH-9 W/U.S. 202 W - **13.7 mi**
Merge onto U.S. 202 W via the ramp to NH-149/Peterborough - **6.8 mi**
Turn left to stay on U.S. 202 W - **3.3 mi**
Turn right at NH-137 S/Bennington Rd - **3.0 mi**
Turn right at NH-123 N/NH-137 S/Main St - **0.2 mi**
Slight left at NH-137 S/Hancock Rd/Old Hancock Rd; Continue to follow NH-137 S - **3.5 mi**
Turn right at Hancock Rd - **1.1 mi**
Continue straight onto Jaquith Rd - **89 ft**
Continue onto Hancock Rd - **3.3 mi**
Turn right at Lower Main St/Main St - **0.2 m**
Take the 1st right onto Main St - **0.4 mi**
Continue onto Chesham Rd - **1.6 mi**
Turn right at Seaver Rd - **0.4 mi**
Park approximately 40 yds past dock on right side of road - **END**

Launch Site Description

The launch site, ~30 yards past the dock on the right side of Seaver Rd, is sandy with scattered rocks. The slope of the shore is gentle but drops significantly once in the water. Launching from this site should be easy and allow for effective access to the sampling point on the reservoir. The launch is a public recreation area.

Launch Site - drawn down in 2002

Launch Site - in 2003

Harrisville,

New Hampshire

Coordinates:

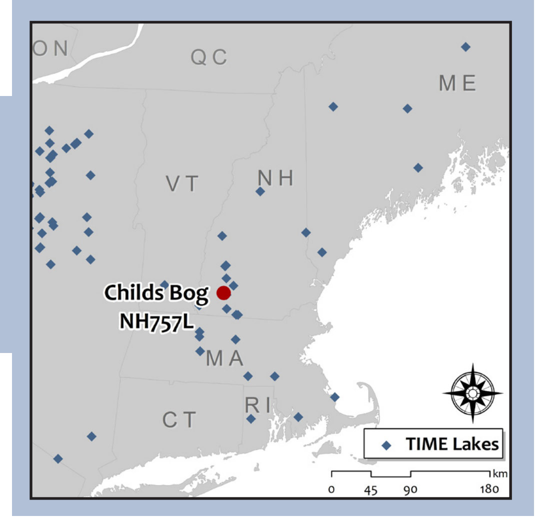
Sampling Point:
N 42.94377
W 72.12810

Launch Point:
N 42.94299
W 72.13022

Childs Bog

Lake ID: NH757L

Other IDs/names: NHLAK802010202-02



Lake description

With the purpose of recreational use, Childs Bog was created in 1924 by damming a tributary of the Minnewawa Brook. Its surface area is approximately 115 acres and its north, east and south shores are comprised of mostly conservation land (see Seaver Reservoir). Currently the dam is owned by NH Water Resources Council, a state entity. The pond is listed as oligotrophic by NH DES.[1]

In 1994, the US EPA sampling team reported that the local contact noted the lake had been drained to construct a new dam at the southeast corner of the lake. The sampling team also noted many drowned tree stumps, leading them to conclude there must have been significant increases in lake size due to the damming.

In addition to small, fringing conserved lands, Childs Bog is within the proposed "Supersanctuary" conservations area (see Seaver Reservoir).[2] The Mondadnock-Sunapee Greenway runs along the lake's southeast shore.

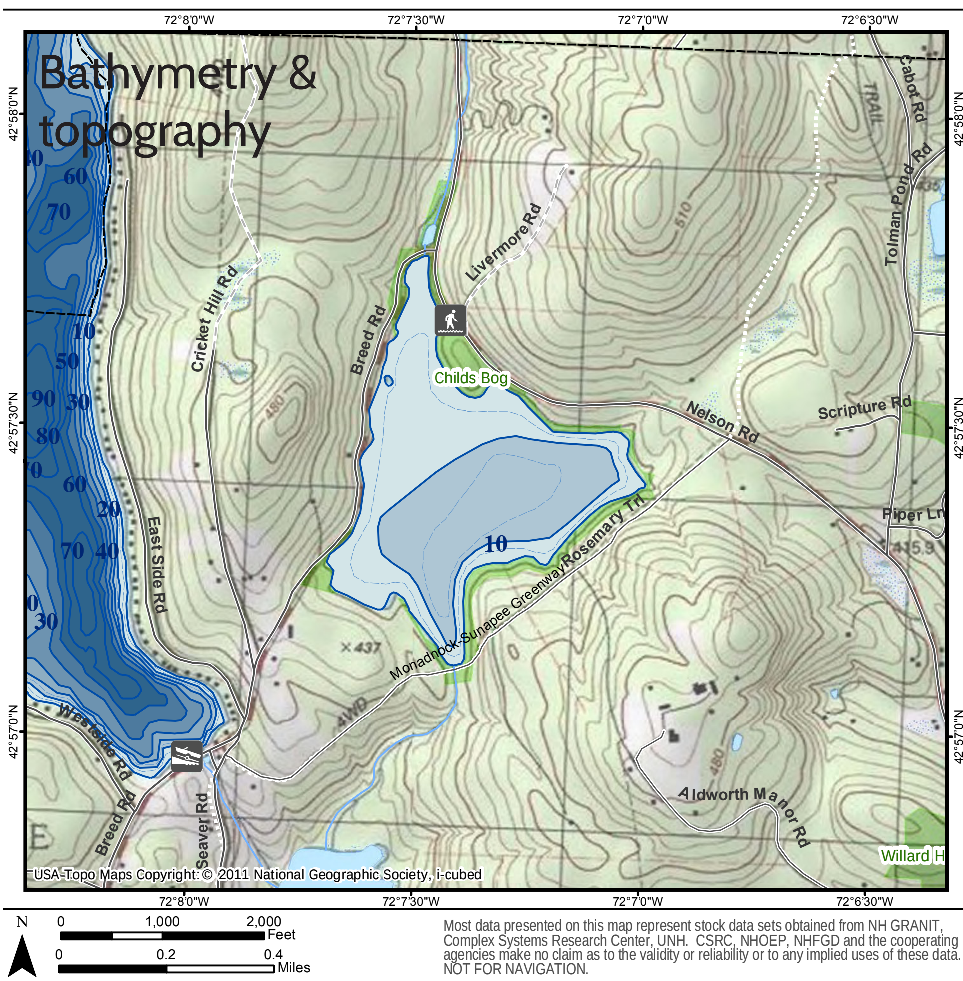
Biota

Zooplankton: Sampled in 1994 as part of EMAP, zooplankton species richness in Childs Bog was moderately high compared to the median for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Gomphidae* were collected.

Fisheries: Five fish species are listed by NH Fish and Game in Childs Bog; seven species were identified in the EMAP 1994 survey.[3,5]

Birds: Breeding bird richness was moderately low as compared to the set of all EMAP lakes surveyed.[3] An adult loon was observed in 2012.



FISHERY: Warmwater ACRES: 115

TROPHIC LEVEL: OLIGO

AVG. DEPTH: 8 MAX. DEPTH: 16

SPECIES: LMB,ECP,HP,BG,YP

ADDITIONAL INFO:

ACCESS: shorebank

Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nhmarinepatrol.com

Public Water Access site

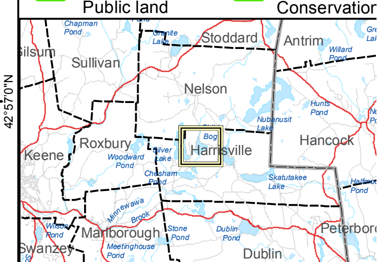
- Canoe/cartop
- Shorebank
- Ramp

Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Restricted Access Conservation

Cleared, Forest, Contour, Building — Source: USGS



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability of any implied uses of these data. NOT FOR NAVIGATION.

Directions: Nelson Rd

Table NH757L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	48.7
Watershed area (ha)	483.8
Mean depth (m)	2.4[3]
Max depth (m)	5.39[3]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	human-made, dammed
Topography	
Minimum watershed elevation (m)	510
Maximum watershed elevation (m)	523
Mean watershed slope (degrees)	13.5
Landcover (% of total watershed)	
Open water	9.7
Developed, open space and low-intensity (<50% impervious)	5.5
Barren	0.1
Deciduous forest	37.2
Evergreen forest	7.0
Mixed forest	37.6
Shrub & Herbaceous	0.2
Agriculture (hay, cultivated)	1.5
Wetlands	1.4
Mean Impervious surface (% of total watershed)	0.3
Bedrock Geology	
Devonian and Silurian eugeosynclinal	

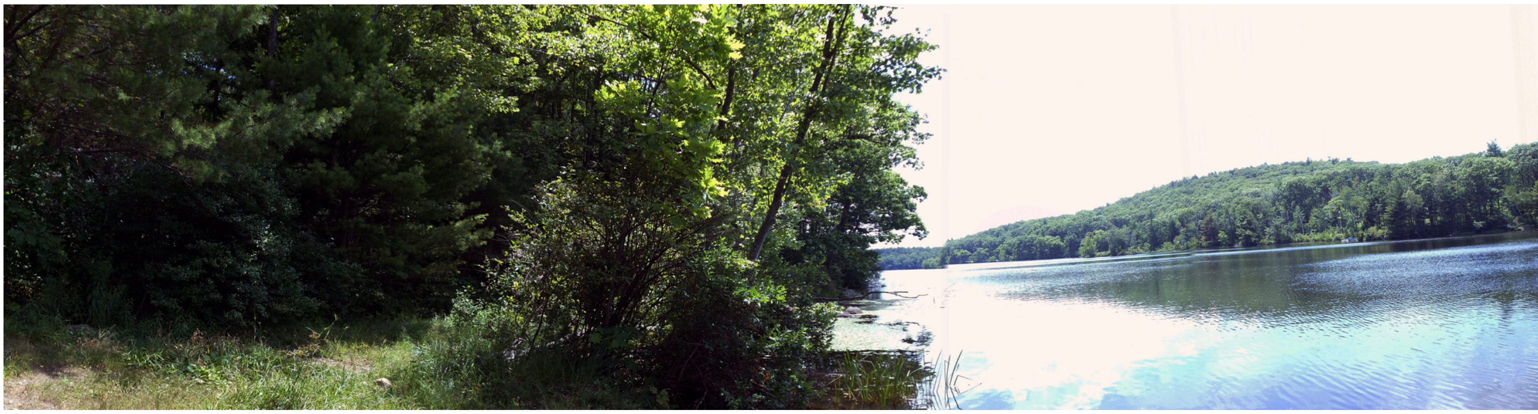
Table NH757L.2. Long-term chemistry for Child's Bog, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.73	0.13	12
ClpH	pH units	6.33	0.16	12
ANC	$\mu eq \cdot L^{-1}$	39.0	8.8	12
DOC	$mg \cdot L^{-1}$	2.58	0.35	12
Cond	$\mu S \cdot cm^{-1}$	69.2	15.1	12
Color*	Pt-Co units	15|19	3|10	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	58.3	7.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	50.1	3.8	12
K^+	$\mu eq \cdot L^{-1}$	15.3	2.1	12
Na^+	$\mu eq \cdot L^{-1}$	446.8	96.1	12
Al (Total)	$\mu g \cdot L^{-1}$	26.2	10.6	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	80.4	11.0	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^-	$\mu eq \cdot L^{-1}$	436.6	112.3	12
SiO_2	$mg \cdot L^{-1}$	1.77	0.84	10
Total P	$\mu g \cdot L^{-1}$	10.3	4.4	5
Total N	$\mu g \cdot L^{-1}$	176	73	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Chloride is extremely high in Childs Bog; given its proximity to roads, it is most certainly road salt affected. Chloride has ranged up to 658 μeq/L in 2003.
- This pond was human-made for recreation purposes. Despite its name, it not a bog.



Sampling history and other studies

Child's Bog was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Child's Bog, diatom-inferred pH was 6.63 in the bottom (pre-1850) section, and 6.53 in the top (recent) section.[3]

Childs Bog is listed as impaired for aquatic life, due to pH/acidity, and fish consumption, due to mercury, as are all NH lakes. TMDLs are in place for both impairments.[6] Childs Bog was sampled in the NH/VT REMAP project in 1999.[7]

Childs Bog was sampled by NH DES in 1984 and 1998; pH was 5.9 and 6.1, respectively, and Secchi transparency was 3.0 and 2.5 m, respectively.[1] Conductivity was 45.7 µS/cm in 1984 and 59 µS/cm in 1998.[1] Conductivity and chloride peaked in the TIME dataset during 2001–2003, years when a severe drought affected New England (2003 immediately followed the drought).

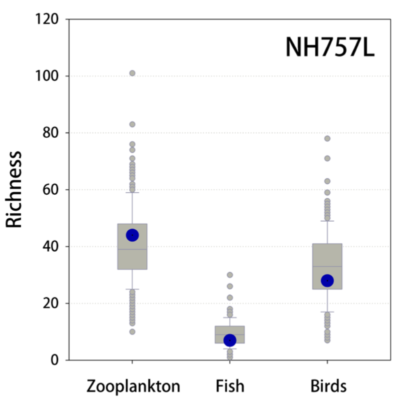


Figure NH757L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).

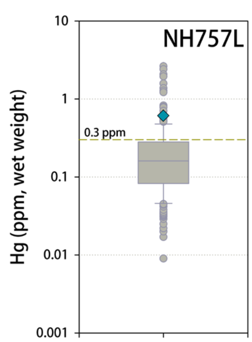


Figure NH757L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot), sampled in 1994. Childs Bog's chain pickerel (*Esox niger*) samples had 0.610 ppm of Hg, exceeding the US EPA advisory level of 0.3 ppm.

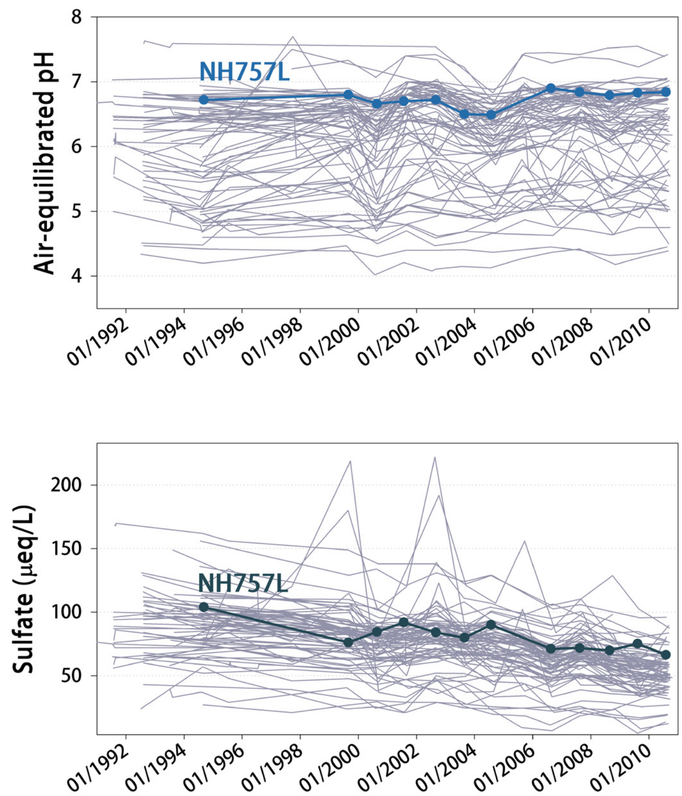


Figure NH757L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Childs Bog has had among the highest pH and sulfate measurements in the TIME dataset. pH has been stable; sulfate has declined slightly through the period of record.

References

[1] NH DES, 2009.

[2] Harris Center for Conservation Education, 2013.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] NH Fish and Game Department, 2009.

[6] US EPA, 2013.

[7] Kamman *et al.*, 2004.

Site access

From NH-101 — 3.8 mi

Turn onto Chesham Rd - **1.0 mi**
Slight left to stay on Chesham Rd - **0.4 mi**
Continue onto Breed Rd - **2.4 mi**
Right onto Nelson Rd - **Approx. 100yds**
Take next right down steep, gravel boat launch - **END**

From Concord, Interstate 89 — 1 hr, 25.7 mi

Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W/U.S. 202 W; Continue to follow NH-9 W - **29.8 mi**
Turn right at Granite Lake Rd - **1.3 mi**
Slight left to stay on Granite Lake Rd - **177 ft**
Take the 1st left onto Murdough Hill Rd - **1.2 mi**
Take the 3rd left onto Nelson Rd/Sullivan Rd - **1.2 mi**
Turn right at Nelson Rd - **1.5 mi**
Continue onto Silver Rd (Nelson Rd becomes Silver Rd) - **Approx. 100 yds**
Take next right down steep, gravel boat launch - **END**

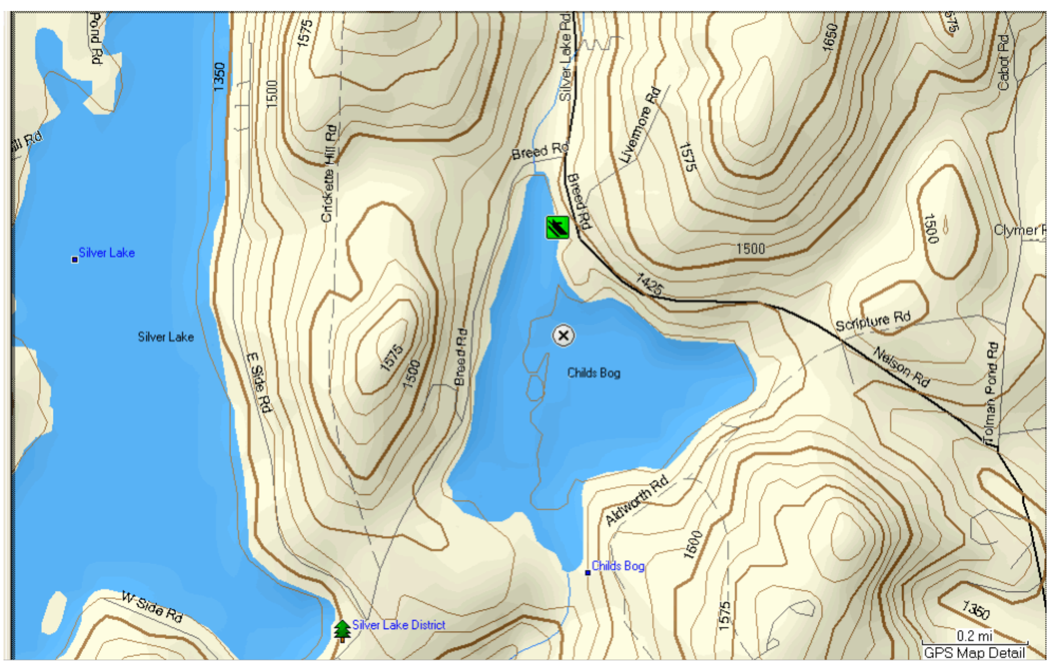
Launch Site Description

The launch site is accessible by a short dirt road on the northwest shore, off of Silver Rd. At the end of the dirt road there is adequate room for parking and turning around. Launch from where the dirt road meets the edge of the water. The launch is steep.


Launch Site - 2002


Launch Site - 2003


Parking - 2003



Harrisville,

New Hampshire

Coordinates:

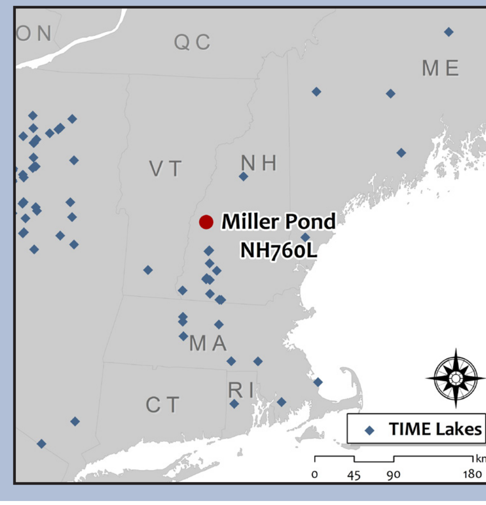
Sampling Point:
N 42.95825
W 72.12372

Launch Point:
N 42.96119
W 72.1297

Miller Pond

Lake ID: NH760L

Other IDs/names: NHLAK801060401-11

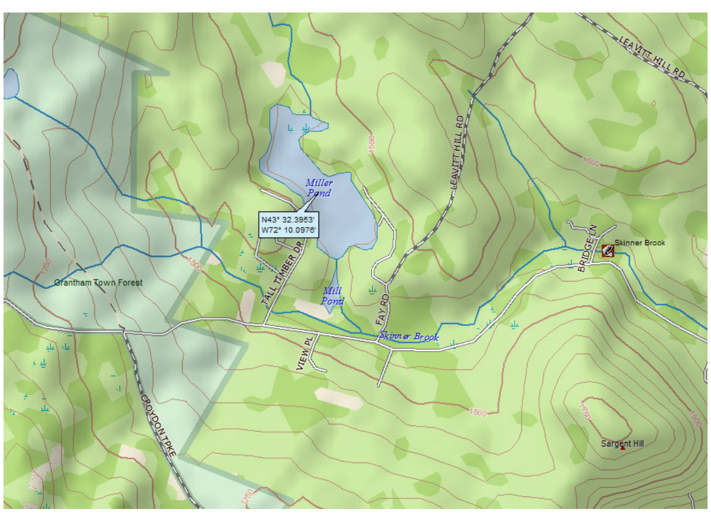


Lake description

Miller pond is a relatively small TIME Lake with only 38 acres of surface area and an average depth of 1.3 meters. It is mesotrophic.[1] It has a secluded feel with only a few homes along its shores and lack of public access, despite access suppposedly provided through the 433.8-acre Grantham Town Forest.[2] In 2010 there was noticeable loon and beaver activity at the pond.

The Town of Grantham has an active conservation commission with pending regulations on wetlands in town; there was also an extensive inventory of critical conservation lands completed in 2009.[2] The inventory mapped existing conserved lands, which cover most of the watershed of Miller Pond. Miller Pond is also located within one of the largest categories of unfragmented lands in the region, between 2,500–10,000 acres in size.[2] The conserved lands bordering Miller Pond are managed: "The Sherwood and Flewelling properties include 4,500 feet of frontage on Miller Pond and its associated wetlands and streams. The property is actively managed for timber production along with the adjacent Town Forest which borders the property to the west".[2] "High" and "very high" value wetlands fringe the pond in several areas.[3]

There is an active, privately-owned earthen dam constructed for recreational uses on the southern end of the pond,[2] although it is not listed in state dam inventories. The Conservation Inventory notes that Miller Pond Dam provides recreational value and has created important wildlife habitat for 'alternative fisheries'.[2]



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1994. Zooplankton species richness in Miller Pond was moderately low, as compared to all EMAP lakes sampled.[4]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, *Macromiidae*, and *Libellulidae* were collected.

Fisheries: There are no known survey data on presence or extirpation, based on NH or EMAP data sources.[4]

Birds: Breeding birds were not listed in EMAP data tables.[4]

The Grantham Conservation Inventory analyzed habitat characteristics across the town and found that the area surrounding Miller Pond should be a relatively high priority conservation area, based on co-occurrence mapping of attributes such as soils, wetlands, fragmentation, and other habitat features.[2]

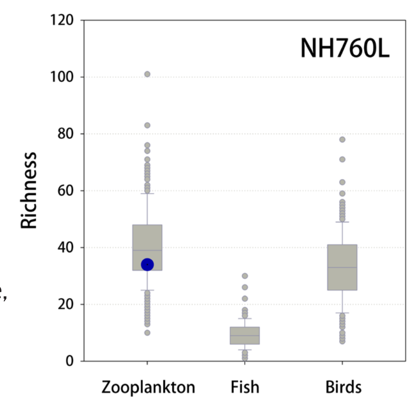


Figure NH760L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[4] (gray box plot) and for this lake, Miller Pond (blue dot).

Bathymetry

No bathymetric map is available. The depth at the 2012 sampling site was ~2 m.

Table NH760L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	15.6
Watershed area (ha)	407.4
Mean depth (m)	1.3[1]
Max depth (m)	2.2[1]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	438
Maximum watershed elevation (m)	602
Mean watershed slope (degrees)	7.4
Landcover (% of total watershed)	
Open water	4.9
Developed, open space and low-intensity (<50% impervious)	0.6
Deciduous forest	39.3
Evergreen forest	4.7
Mixed forest	47.4
Shrub & Herbaceous	1.0
Wetlands	4.6
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Ordovician volcanic rocks	

Table NH760L.2. Long-term chemistry for Miller Pond, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.83	0.14	12
ClpH	pH units	6.46	0.23	12
ANC	$\mu eq \cdot L^{-1}$	57.5	14.1	12
DOC	$mg \cdot L^{-1}$	4.72	0.78	12
Cond	$\mu S \cdot cm^{-1}$	17.7	1.3	12
Color*	Pt-Co units	11|25	5|6	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	91.5	10.4	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	26.2	2.8	12
K^{+}	$\mu eq \cdot L^{-1}$	6.4	2.2	12
Na^{+}	$\mu eq \cdot L^{-1}$	36.7	3.7	12
Al (Total)	$\mu g \cdot L^{-1}$	24.7	18.5	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	68.2	12.8	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	12.4	3.7	12
SiO_2	$mg \cdot L^{-1}$	1.38	1.27	10
Total P	$\mu g \cdot L^{-1}$	6.6	1.9	5
Total N	$\mu g \cdot L^{-1}$	248	58	9

* Color is displayed as True|Apparent

Site disturbance & considerations

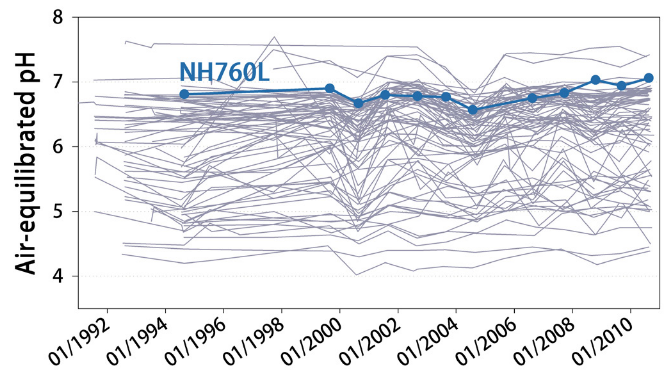
- Miller Pond is relatively undisturbed; chloride concentrations are well below the threshold for 'background' (20 μeq/L) in non-coastal lakes, indicating no road salt inputs.
- Conservation easements near the pond are actively managed for timber production.

Sampling history and other studies at this lake

Miller Pond was not cored in the 1991–1995 EMAP sediment survey.

Miller Pond Bog was sampled by NH DES in 1991; pH was 6.7, Secchi transparency was >2.1 m, aquatic plants were reported to be abundant.[1]

In addition to its impairment for mercury (fish consumption) as with all NH lakes, Miller Pond was assessed and status was "good" in 2008 with respect to drinking water after treatment.[6]



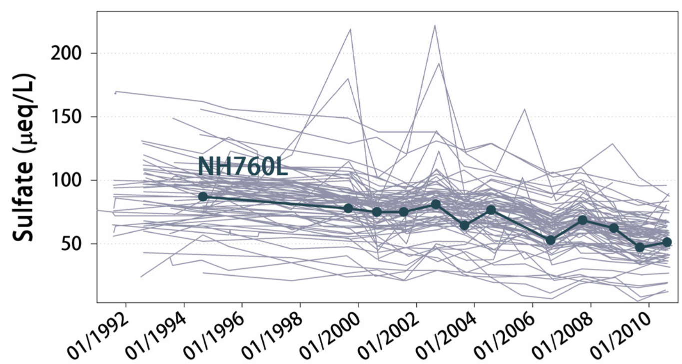
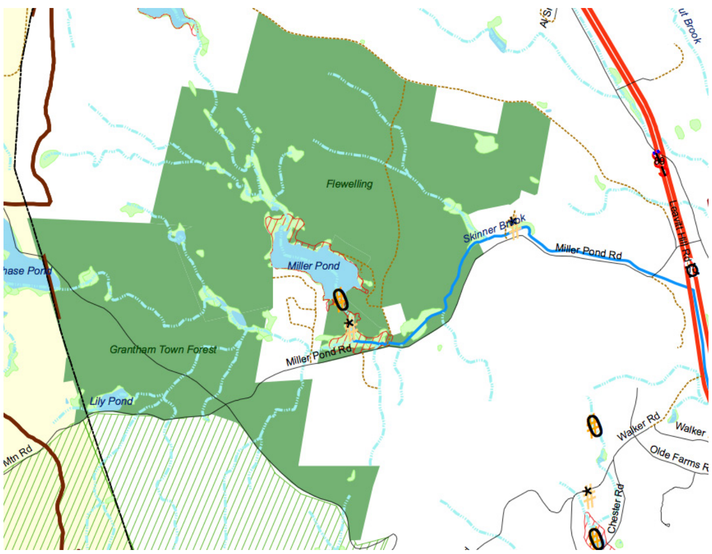
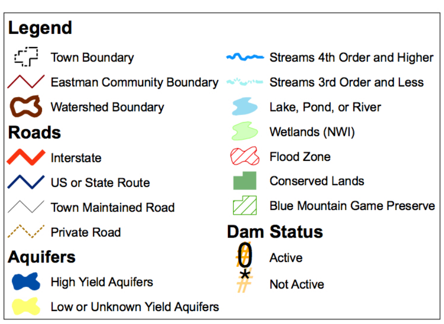


Figure NH760L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Miller Pond (thick blue line) has had among the highest pH among TIME lakes. pH could be very slightly increasing; sulfate concentrations, which are realtively low, have nonetheless been steadily declining in this fairly remote pond since EMAP sampling began.





Excerpt from Water Resources map in Critical Conservation Inventory, 2009.[2]

References

1 NH DES, 2009

2 Gagne, 2009.

3 Rick Van de Poll, 2012.

4 US EPA, 2012.

5 Nelson *et al.*, 2011.

6 US EPA, 2013.

Miller Pond in 2003. Photo: C. Schmitt

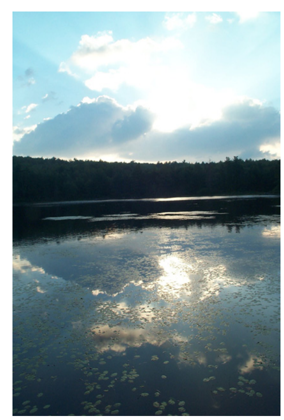


Photo date: September, 2012 • Credit: A. Baumann

Site access

From Concord, Interstate 89 — 55 min, 45.8 mi

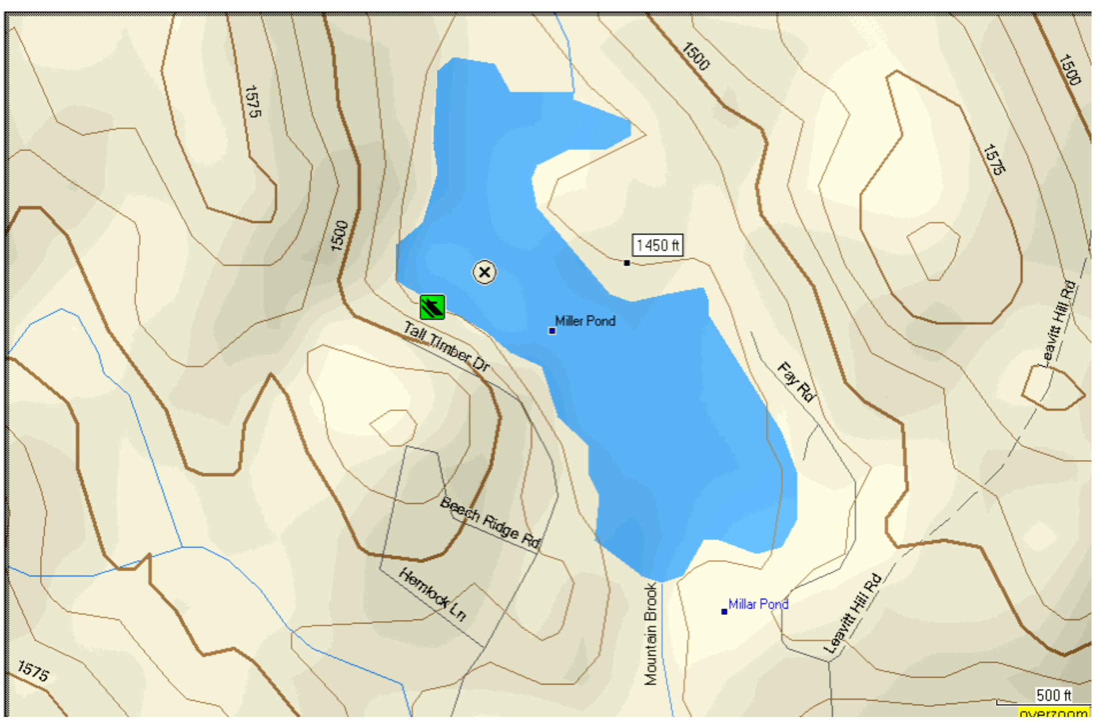
Take I-89 N - **40.6 mi**

Take exit 13 for NH-10 toward Grantham/Croydon - **0.3 mi**

Turn right at Old New Hampshire 10 (North) - **2.5 mi**

Turn left at Miller Pond Rd - **1.9 mi**

Turn right at Tall Timber Dr - **0.5 mi**



Grantham,

New Hampshire

Coordinates:

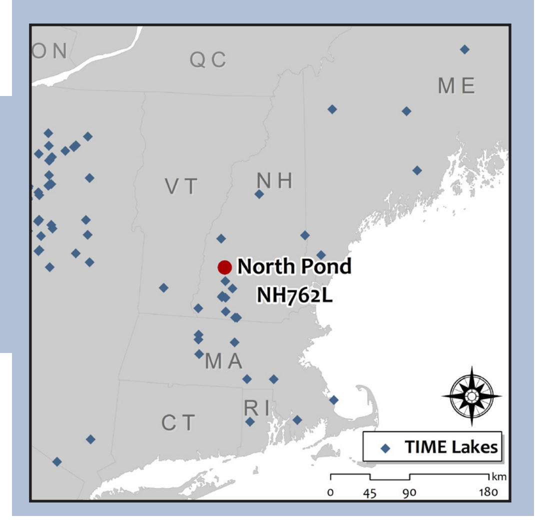
Sampling Point:
N 43.54081
W 72.17012

Launch Point:
N 43.54049
W 72.17111

North Pond

Lake ID: NH762L

Other IDs/names: NHLAK802010101-07



Lake description

Both North Pond and May Pond are in Pillsbury State Park (>5,000 acres), with a primitive campground and recreation areas, in Washington, NH. The Park is part of the 50 mile Monadnock-Sunapee Greenway trail. Unlike May Pond, North Pond has only two walk-in campsites and is in a more secluded area. The area around the pond is very scenic; the hike to the pond offers the chance to see wildlife such as beaver, moose or black bear.

The pond is eutrophic; emergent vegetation is abundant. North Pond is on New Hampshire's list of acidified ponds (ANC<0).[1] Both North and May Ponds have very low chloride, indicating no road salting in the watershed.

The Town of Washington has a rural character, with much of the town in unfragmented blocks of forest and protected lands. The Town has a natural resource inventory; North Pond is already protected due to state ownership of surrounding land, but it also is the location of important Marsh and Shrub Wetland habitat.[2]

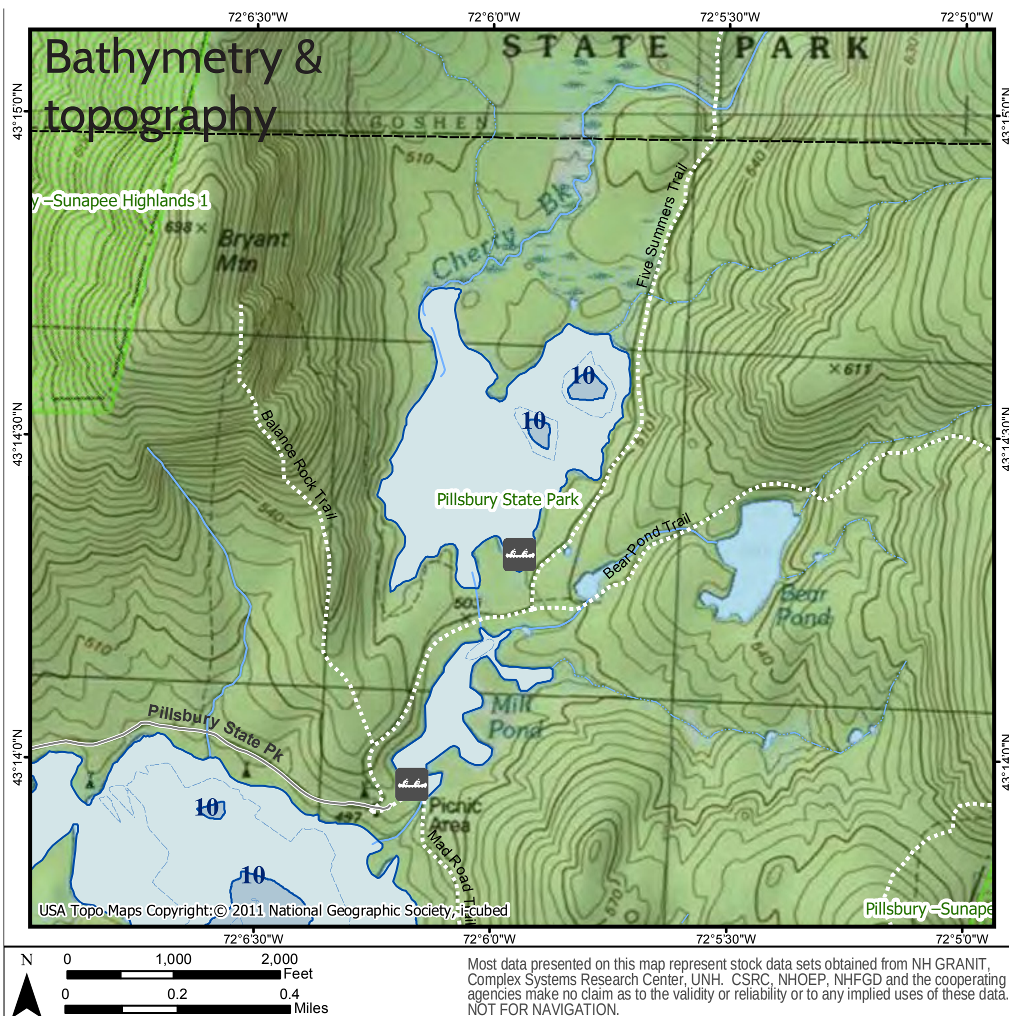
Biota

Zooplankton: Sampled in 1994, zooplankton species richness in North Pond was slightly greater than the 75th percentile for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: Three fish species are listed by NH Fish and Game;[5] no fish data were listed in EMAP data tables.[3]

Birds: No data were listed in EMAP data tables.[3]



Most data presented on this map represent stock data sets obtained from NH GRANIT, Complex Systems Research Center, UNH. CSRC, NHOEP, NHFGD and the cooperating agencies make no claim as to the validity or reliability or to any implied uses of these data. NOT FOR NAVIGATION.

FISHERY:	Warmwater	ACRES:	56
TROPHIC LEVEL:	EUTRO		
AVG. DEPTH:	3	MAX. DEPTH:	10
SPECIES:	ECP,HP,YP		

ADDITIONAL INFO:

ACCESS: cartop

Please contact NH Dept of Safety, Marine Patrol for info. on water body/boat/motor restrictions: (603) 293-2037 www.nhmarinepatrol.com

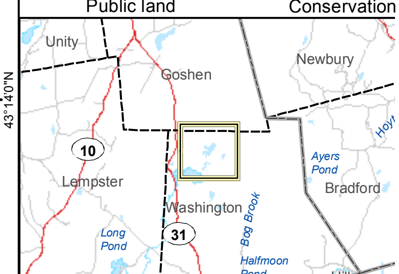
Public Water Access site

- Canoe/cartop
- Shorebank
- Ramp
- Bathymetric contour (feet)

Bathymetry provided by the NH Department of Environmental Services, Watershed Mgt Bureau

- Town boundary
- Primary Route
- Road or Street
- Trail or other
- Stream or Shoreline
- Surface Water
- Wetland
- Conservation or Public land
- Restricted Access Conservation

Cleared, Forest, Contour, Building — Source: USGS



Directions: Pillsbury State Park, Five Summers trail

Table NH762L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	31.8
Watershed area (ha)	856.6
Mean depth (m)	1[1]
Max depth (m)	4.6[1]
Drainage class	drainage
Number of inlets	2
Number of outlets	1
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	503
Maximum watershed elevation (m)	770
Mean watershed slope (degrees)	3.4[3]
Landcover (% of total watershed)	
Open water	2.3
Developed, open space and low-intensity (<50% impervious)	0.7
Deciduous forest	83.0
Evergreen forest	3.9
Mixed forest	5.4
Shrub & Herbaceous	0.2
Wetlands	3.6
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology (% of total watershed)	
• Devonian eugeosynclinal (87%) • Middle Paleozoic granitic rocks (12%) • Devonian and Silurian eugeosynclinal (1%)	

Table NH762L.2. Long-term chemistry for North Pond, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.80	0.23	13
ClpH	pH units	5.58	0.16	13
ANC	$\mu eq \cdot L^{-1}$	12.5	4.6	13
DOC	$mg \cdot L^{-1}$	6.19	1.39	13
Cond	$\mu S \cdot cm^{-1}$	14.3	1.6	13
Color*	Pt-Co units	20|27	8|8	7|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	52.9	5.2	13
Mg^{2+}	$\mu eq \cdot L^{-1}$	17.9	2.1	13
K^{+}	$\mu eq \cdot L^{-1}$	2.3	1.6	13
Na^{+}	$\mu eq \cdot L^{-1}$	37.6	5.9	13
Al (Total)	$\mu g \cdot L^{-1}$	125.8	63.6	13
SO_4^{2-}	$\mu eq \cdot L^{-1}$	67.0	13.2	13
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	13
Cl^{-}	$\mu eq \cdot L^{-1}$	8.3	2.1	13
SiO_2	$mg \cdot L^{-1}$	1.06	1.28	11
Total P	$\mu g \cdot L^{-1}$	9.5	6.1	6
Total N	$\mu g \cdot L^{-1}$	309	99	10

* Color is displayed as True|Apparent

Site disturbance & considerations

- Upon entry of Pillsbury State Park, check in at the campground office.
- Leeches were abundant in North Pond in 2012.

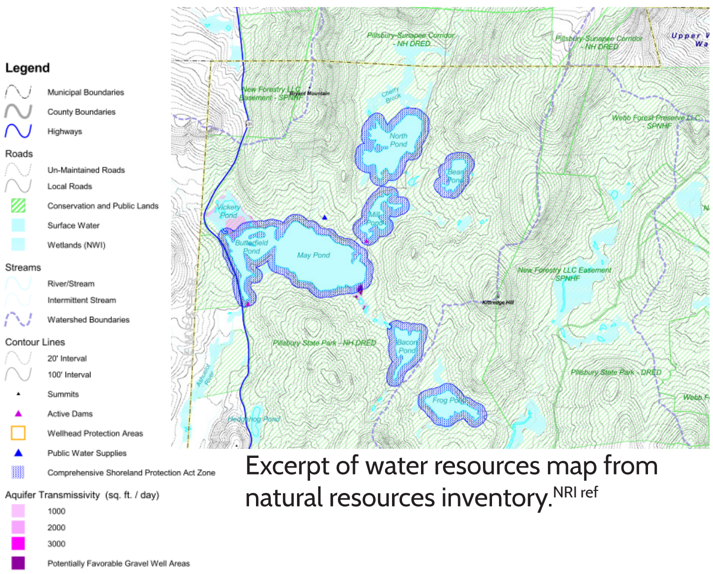
Sampling ponds at Pillsbury State Park is always a high point in the Northeast campaign. The EPA sampling crew in 1995 wrote that the Park staff were extremely excited to have them sampling; they offered canoes for sampling and even went to get ice for the crew, who camped in the Park. The EPA team in 1995 also "took a high school student (hopefuly Environmental Science Major in college) out with us to get her feet wet in environmental studies".

Sampling history and other studies at this lake

North Pond was not cored in the 1991–1995 EMAP sediment survey.[3]

North Pond was sampled by NH DES in 1984 and 2004; pH was 5.4 and 5.52, respectively, and Secchi transparency was 2.8 m in 2004.[1] Chlorophyll-a was 6.4, plants were "very abundant", and the lake was classified as eutrophic.[1]

North Pond is listed as impaired as of 2010 for aquatic life, due to pH/acidity, and fish consumption, due to mercury, as are all NH lakes. TMDLs are in place for both impairments.[6]



Excerpt of water resources map from natural resources inventory.[NRI ref]

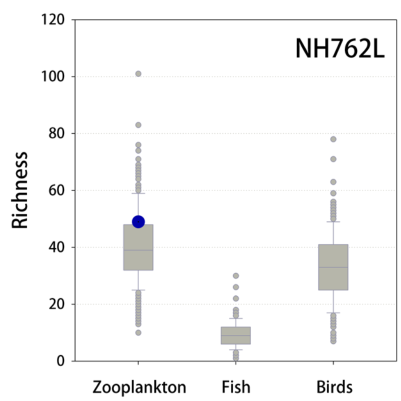


Figure NH762L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this pond (blue dot).

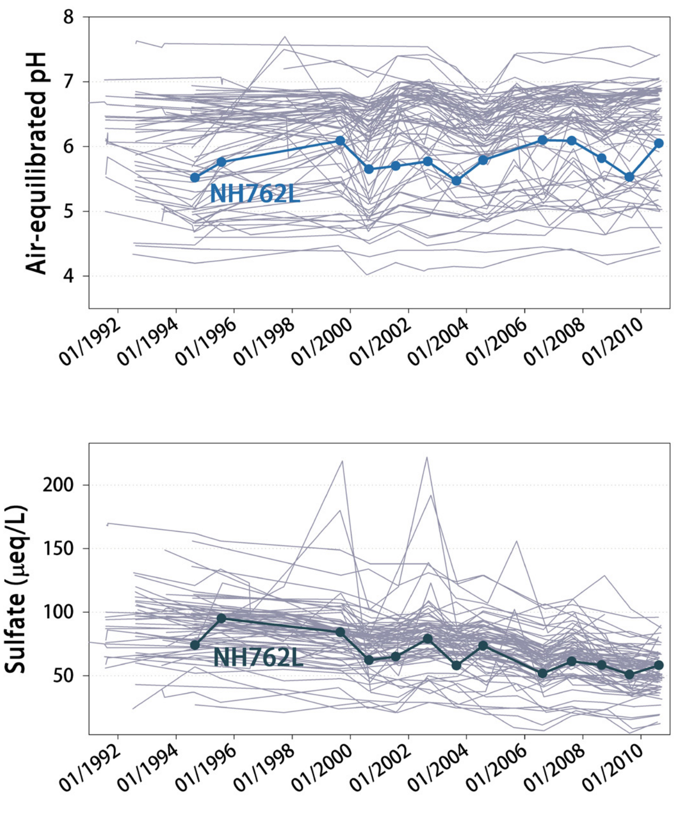


Figure NH762L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). North Pond (thick blue line) has relatively low pH and sulfate measurements compared to the TIME dataset. Sulfate has declined through the TIME sampling duration. TIME project pH appears greater than it has been in state surveys, which put it on the state's acidified ponds list.[1]

References

[1] NH DES, 2009.

[2] Kane and Ingraham, 2008.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] NH Fish and Game Department, 2009.

[6] US EPA, 2013.


Photo date: July 5, 2012 • Credit: S. Nelson

Site access

From Concord, Interstate 89 — 50 min, 30.6mi

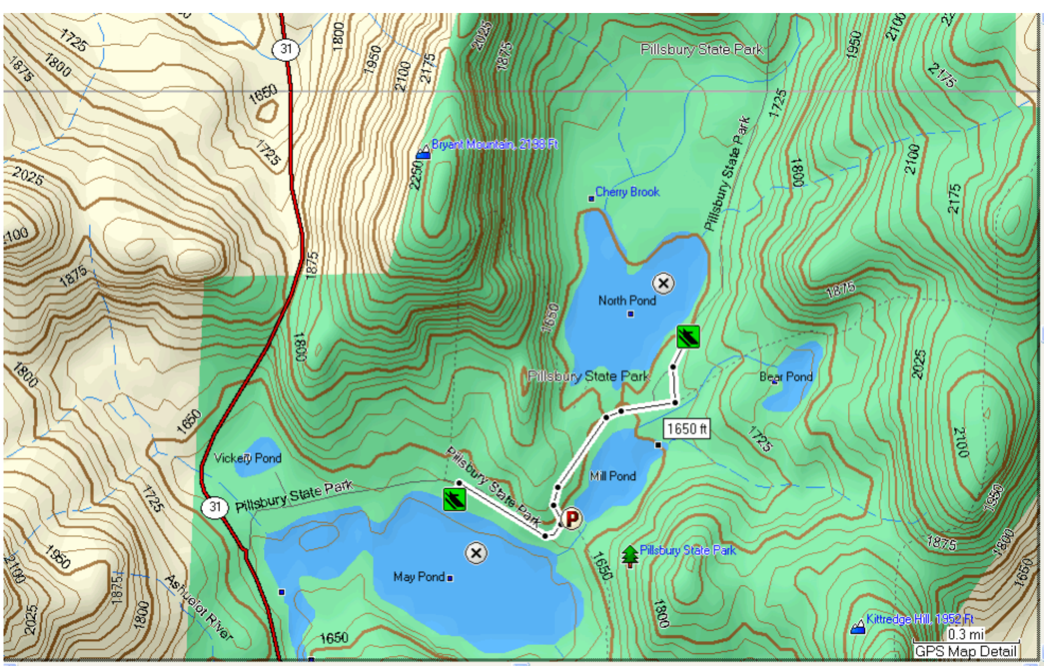
Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W/U.S. 202 W; Continue to follow NH-9 W - **15.7 mi**
Turn right at NH-31 N/2nd New Hampshire Turnpike; Continue to follow NH-31 N - **13.4 mi**
Slight right at Clemac Trail/Pillsbury State Park Rd - **1.1 mi**
*Upon entering the park check in at the campground office
North Pd launch: Park at gate/turn around next to Mill Pond - **END**

Launch Site Description

After parking at Mill Pond (near the gazebo) hike up the Five Summers Trail to campsite # 37. From this campsite you will be able to launch from the rocks that meet the water.


North Pond in 2003


From launch, 2003



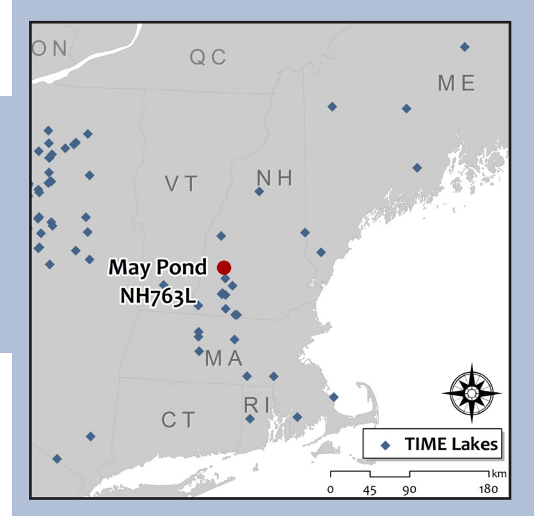
Pillsbury State Park,
Washington,
New Hampshire

Coordinates:
- Sampling Point:
  - N 43.24217
  - W 72.09795
- Launch Point:
  - N 43.23995
  - W 72.09658

May Pond

Lake ID: NH763L

Other IDs/names: NHLAK802010101-05



Lake description

Both North Pond and May Pond are in Pillsbury State Park, with a primitive campground and recreation areas, in Washington, NH. The Park is part of the 50 mile Monadnock-Sunapee Greenway trail. Of the ponds in Pillsbury State Park, May Pond is the largest and most used pond with a surface area of 152 acres and about 22 campsites. During the summer months expect to see and talk with people using the park.

May Pond is mesotrophic. A species of conservation focus in NH, *Gavia immer* (Common Loon) exists in or near May Pond, based on observations of the 2012 sampling team.

As with North Pond, the watershed and shoreline of May Pond is protected due to its location in a State Park. The Town of Washington is largely forested, unfragmented, and rural; see details on natural resources inventory in the description of North Pond.[1]

Biota

Zooplankton: Sampled in 1994, zooplankton species richness in May Pond was slightly lower than the median for all EMAP lakes.[2]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[3] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, *Libellulidae*, and *Macromiidae* were collected.

Fisheries: NH Fish and Game reports three fish species in May Pond.[4] No fish data were listed in EMAP data tables.[2]

Birds: Breeding birds were not listed in EMAP data tables.[2]

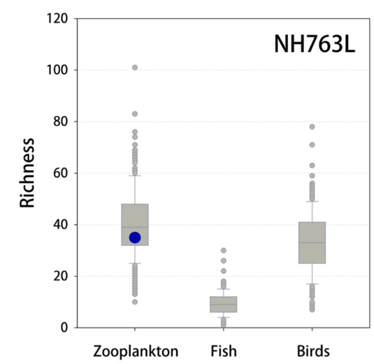


Figure NH763L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[2] (gray box plot) and for this pond (blue dot).

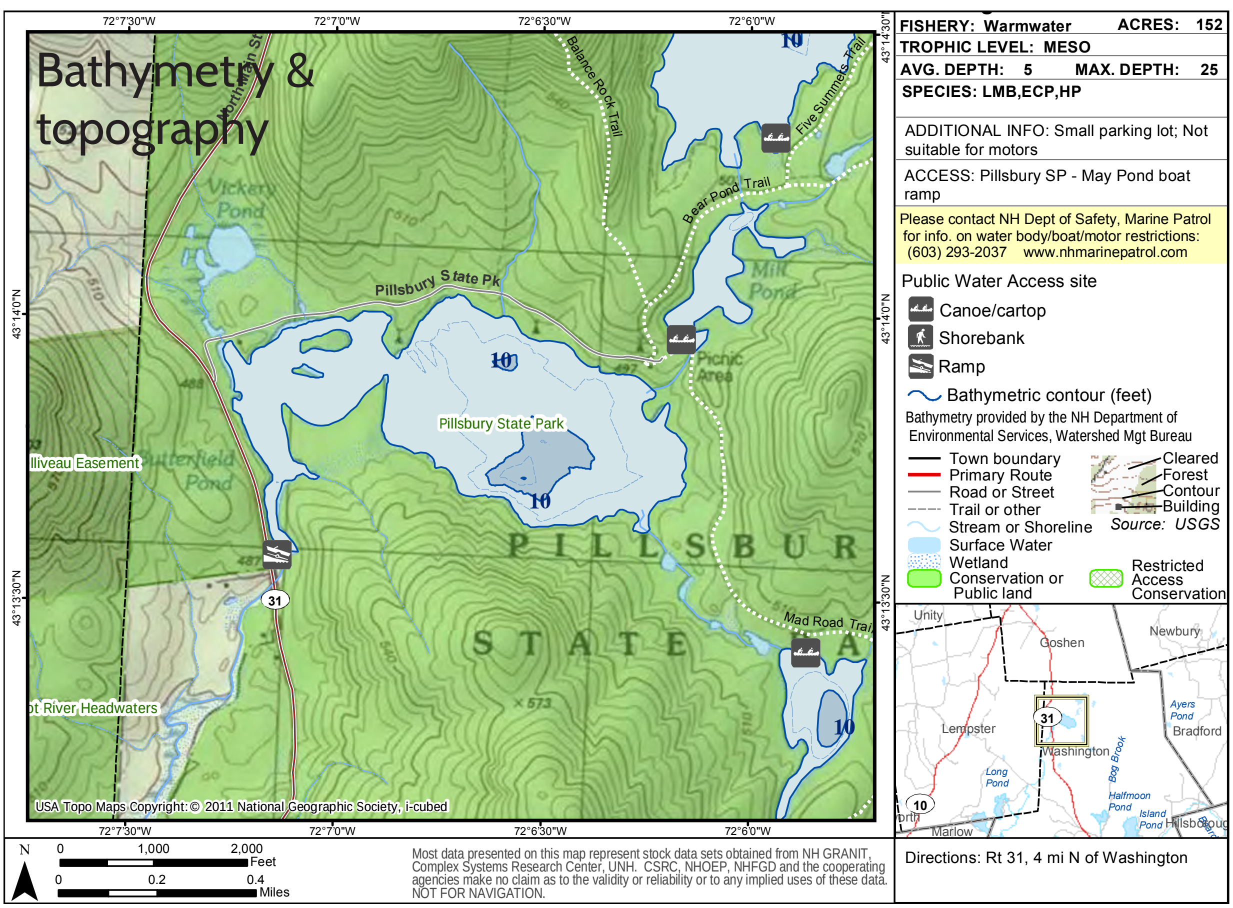


Table NH763L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	62.4
Watershed area (ha)	1770.2
Mean depth (m)	1.5[1]
Max depth (m)	7.6[6]
Drainage class	drainage
Number of inlets	5
Number of outlets	1
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	485
Maximum watershed elevation (m)	770
Mean watershed slope (degrees)	8.8
Landcover (% of total watershed)	
Open water	5.7
Developed, open space and low-intensity (<50% impervious)	1.6
Deciduous forest	71.1
Evergreen forest	6.5
Mixed forest	11.3
Shrub & Herbaceous	0.5
Agriculture (hay, cultivated)	0.1
Wetlands	6.3
Mean Impervious surface (% of total watershed)	0.1
Bedrock Geology (% of total watershed)	
• Devonian eugeosynclinal (75%) • Middle Paleozoic granitic rocks (15%) • Devonian and Silurian eugeosynclinal (10%)	

Table NH763L.2. Long-term chemistry for May Pond, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.05	0.23	12
ClpH	pH units	5.80	0.18	12
ANC	$\mu eq \cdot L^{-1}$	14.3	4.6	12
DOC	$mg \cdot L^{-1}$	4.10	0.85	12
Cond	$\mu S \cdot cm^{-1}$	13.4	1.1	12
Color*	Pt-Co units	9|19	5|8	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	50.5	4.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	18.4	1.5	12
K^{+}	$\mu eq \cdot L^{-1}$	4.1	1.7	12
Na^{+}	$\mu eq \cdot L^{-1}$	34.9	4.9	12
Al (Total)	$\mu g \cdot L^{-1}$	65.1	50.9	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	65.1	10.9	12
NO_3^{-}	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^{-}	$\mu eq \cdot L^{-1}$	9.7	2.6	12
SiO_2	$mg \cdot L^{-1}$	0.56	0.76	10
Total P	$\mu g \cdot L^{-1}$	4.9	2.6	5
Total N	$\mu g \cdot L^{-1}$	218	49	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- Upon entry of Pillsbury State Park, check in at the campground office.
- Expect to encounter people while at the park in summer months.
- In 2012, sampling crews noted signs that the beach at May Pond has leeches and potentially high *E. Coli*, so swimming was not recommended.
- Chloride is very low in May Pond, due to its remote nature away from salted roads.

Sampling history and other studies at this lake

May Pond was not cored in the 1991–1995 EMAP sediment survey.[2]

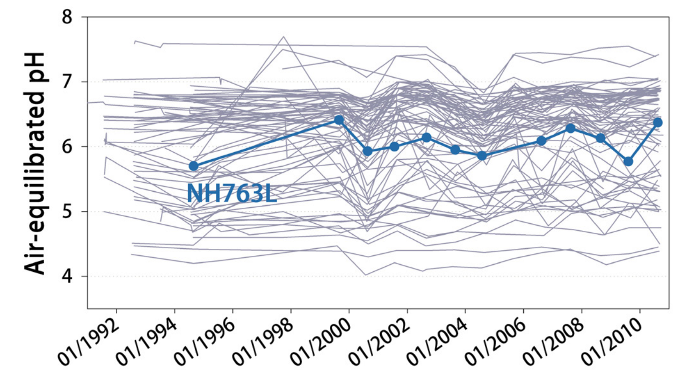
May Pond is listed as impaired as of 2008 for aquatic life, due to pH/acidity, and fish consumption, due to mercury, as are all NH lakes. TMDLs are in place for both impairments.[5]

May Pond was sampled by NH DES in 1984 (pH=5.3), 1999, and 2004 (pH=5.31); not all analyses appear to have been performed in 1999.[6] Secchi transparency was 3.5 m in 1984 and 4.4 m in 2004, but only 1.6 m in 1999, when DES classified the lake as euthrophic based on those results and an increase in abundance of plants, decline in DO, and increase in Chlorophyll-a.[6] These issues seem to have resolved themselves in the 2004 sampling. 1999 was a drought year for part of the summer in New England, which could have contributed to a deviation from typical conditions.

In 2011, the New Hampshire Volunteer Lake Assessment Program reported that average transparency in May Pond was 4.0 m, greater than the NH median of 3.2 m.[7] Total phosphorus (epilimnetic) was 12 µg/L, right at the New Hampshire median value of 12 µg/L.[7] Chlorophyll-a in May Pond was 3.0 mg/m^3, less than the New Hampshire median (4.58 mg/m^3).[7] May Pond had the lowest conductivity of VLAP lakes sampled in its region, 9.2 µMho/cm.[7]

May Pond's outlet was sampled once as part of the NH acid outlets study, in May of 2004.[6] At that time, its pH was 5.49 and color was 25, elevated compared to TIME summer samples and suggesting elevated organic acidity as a mechanism for spring episodic acidification.

May Pond was sampled for mercury in fish by NH DES; it was found to have elevated Hg levels and has a specific waterbody advisory.[8]



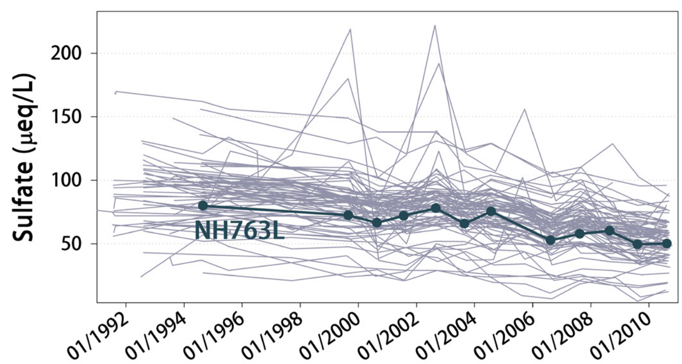


Figure NH763L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). May Pond (thick blue line) has had somewhat low pH and sulfate measurements compared to the rest of the TIME dataset.

May Pond sampling, Adam Baumann, 2012. Photo: S. Nelson.

References

[1] Kane and Ingraham, 2008.

[2] US EPA, 2012.

[3] Nelson *et al.*, 2011.

[4] NH Fish and Game Department, 2009.

[5] US EPA, 2013.

[6] NH DES, 2009.

[7] Steiner, 2012d.

[8] NH Fish and Game Department, 2013.

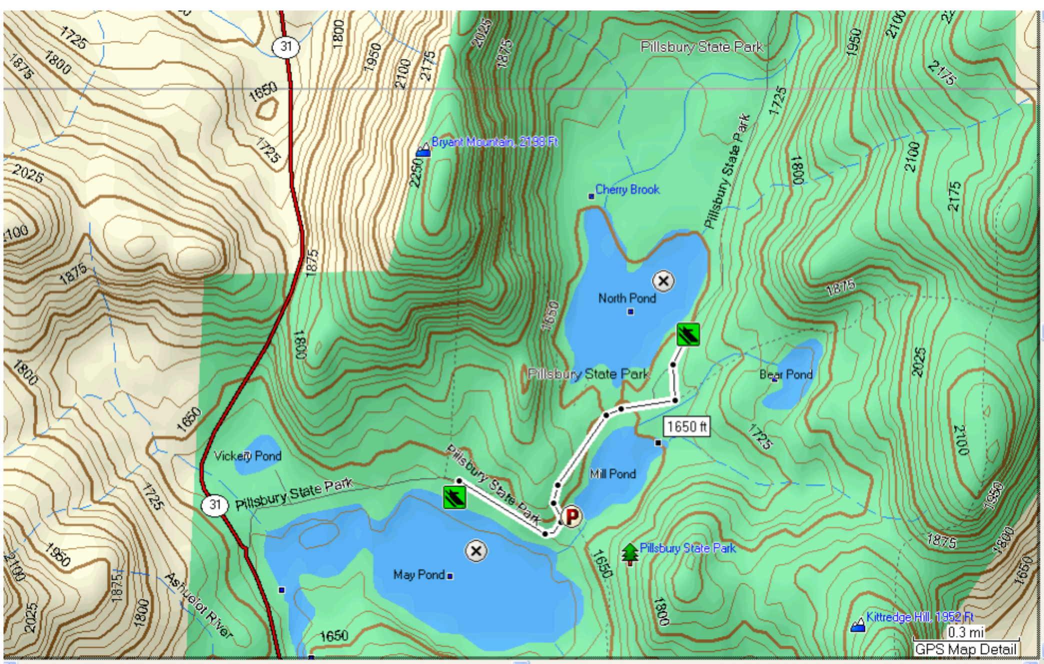
Site access

From Concord, Interstate 89 — 50 min, 30.6mi

Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W/U.S. 202 W; Continue to follow NH-9 W - **15.7 mi**
Turn right at NH-31 N/2nd New Hampshire Turnpike; Continue to follow NH-31 N - **13.4 mi**
Slight right at Clemac Trail/Pillsbury State Park Rd - **0.8 mi**
*Upon entering the park check in at the campground office
May Pond launch: Park at campsites (9-18) on right - **END**

Launch Site Description

The launch site is at campsites 9-18 on the right of Pillsbury State Park Rd. Parking should be available at the campsites, however, check first at the campground office. The launch from the campsites is a gradual slope to the waters edge, an easy launch.



Pillsbury State Park, Washington,

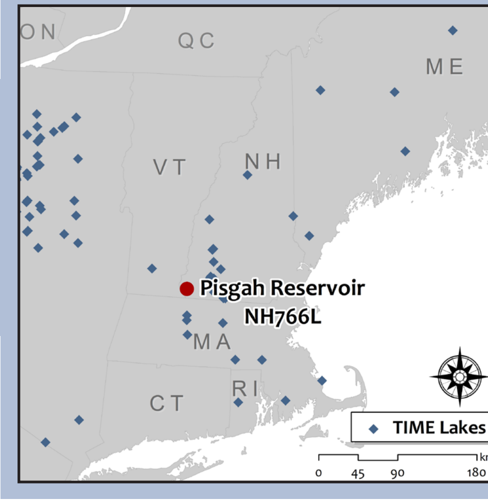
New Hampshire

Coordinates:
- Sampling Point:
  - N 43.23113
  - W 72.10847
- Launch Point:
  - N 43.23113
  - W 72.10847

Pisgah Reservoir

Lake ID: NH766L

Other IDs/names: NHLAK802010403-05



Lake description

Pisgah Reservoir, with its many islands and deep inlets, is located in Pisgah State Park, >13,500 acres of 'rough, forested terrain', the largest State Park in NH, and established in the 1960s. The reservoir is fairly secluded and free of heavy human impact. However, in the summer months, recreational use is moderate to high.

Pisgah Reservoir is mesotrophic and is listed as one of NH's acidic ponds, with pH~5.4 and ANC<0.[1] Shallow, strongly acidic soils contribute to low buffering capacity.[2] Forest covers 85% of Pisgah State Park; the vast majority of this forest is the exemplary natural community hemlock - hardwood - pine forest system.[2] A locally significant natural community (black gum - red maple basin swamp) is also present near the southwestern shore of Pisgah Reservoir.[2] *Myriophyllum farwellii* (Farwell's water milfoil) is a rare aquatic plant with communities in two locations in Pisgah Reservoir.[2]

There is a dam on Tufts Brook, built in 1870[2] for recreational purposes and owned by NH Department of Resources and Economic Development.

Biota

Zooplankton: Zooplankton were sampled in 1994 and 1995 as part of EMAP; species richness in Pisgah was the median across all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, *Gomphidae*, and *Libellulidae* were collected.

Fisheries: Six fish species are listed by NH Fish and Game.[5] No fish data were listed in EMAP data tables.[3]

Birds: Breeding birds were not listed in EMAP data tables.[3]

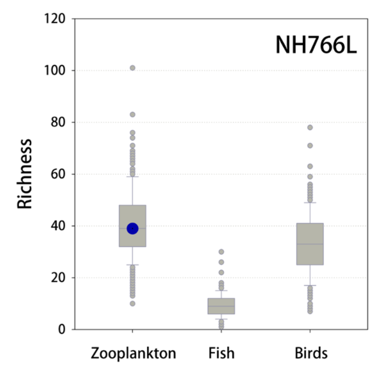


Figure NH766L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot).

Bathymetry & topography

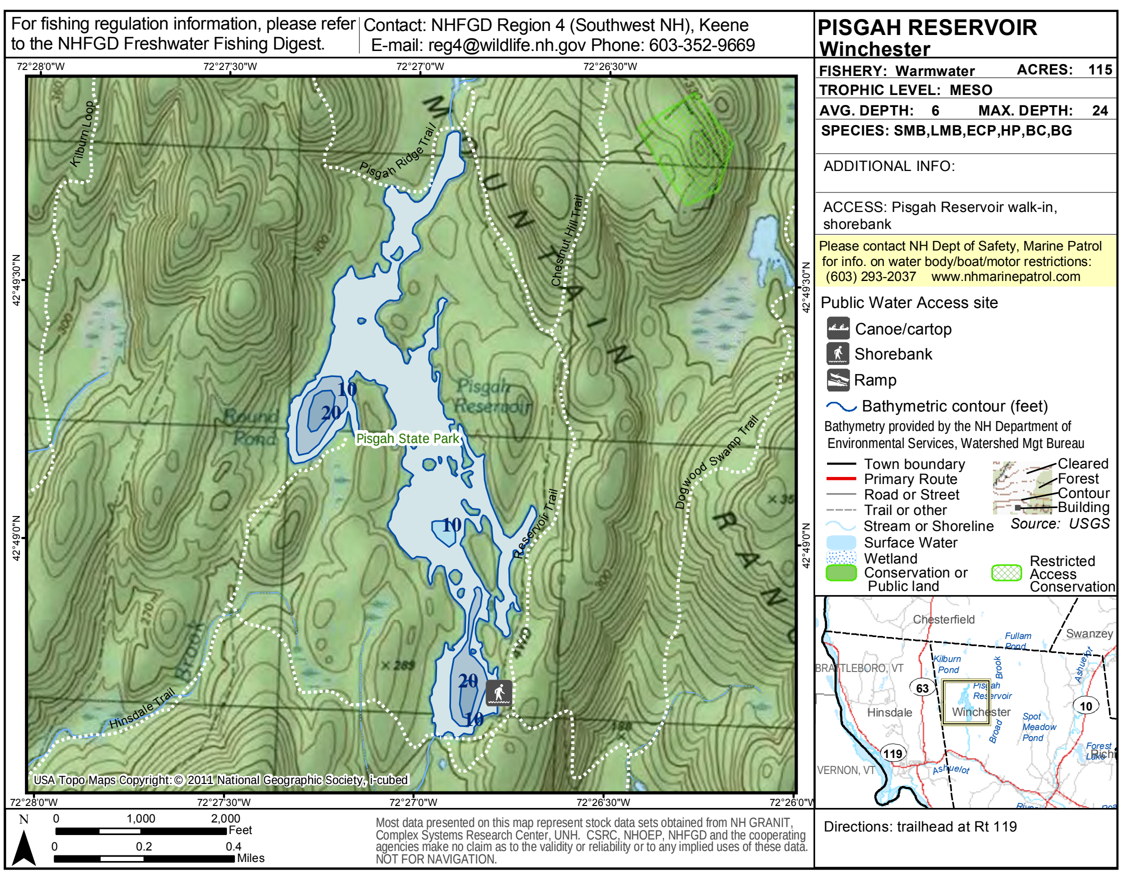


Table NH766L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	54.7
Watershed area (ha)	657.8
Mean depth (m)	1.8[1]
Max depth (m)	7.3[1]
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	268
Maximum watershed elevation (m)	404
Mean watershed slope (degrees)	8.4
Landcover (% of total watershed)	
Open water	7.8
Deciduous forest	39.6
Evergreen forest	39.1
Mixed forest	11.1
Shrub & Herbaceous	0.1
Wetlands	3.8
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Middle Paleozoic granitic rocks	

Table NH766L.2. Long-term chemistry for Pisgah Res., 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	5.43	0.16	13
ClpH	pH units	5.31	0.12	13
ANC	$\mu eq \cdot L^{-1}$	-0.5	4.0	13
DOC	$mg \cdot L^{-1}$	3.27	0.88	13
Cond	$\mu S \cdot cm^{-1}$	16.6	2.2	13
Color*	Pt-Co units	8|15	6|5	7|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	45.1	8.4	13
Mg^{2+}	$\mu eq \cdot L^{-1}$	20.2	4.2	13
K^+	$\mu eq \cdot L^{-1}$	2.9	0.9	13
Na^+	$\mu eq \cdot L^{-1}$	43.9	5.3	13
Al (Total)	$\mu g \cdot L^{-1}$	69.6	21.9	13
SO_4^{2-}	$\mu eq \cdot L^{-1}$	88.4	12.2	13
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	13
Cl^-	$\mu eq \cdot L^{-1}$	16.1	5.1	13
SiO_2	$mg \cdot L^{-1}$	0.50	0.54	11
Total P	$\mu g \cdot L^{-1}$	8.2	4.3	6
Total N	$\mu g \cdot L^{-1}$	183	77	10

* Color is displayed as True|Apparent

Site disturbance & considerations

- For more information about the park go to: www.nhstateparks.org.
- The Park is heavily used by ATVs.[2]
- The Park is unstaffed. In some years, Park staff contacted ahead of time have opened the gate to allow crews to drive closer to the lake.
- The Pisgah area is among the least affected by human disturbance of the NH lakes, documented by paleoecological study within the Park at neaby North Round Pond.[6]

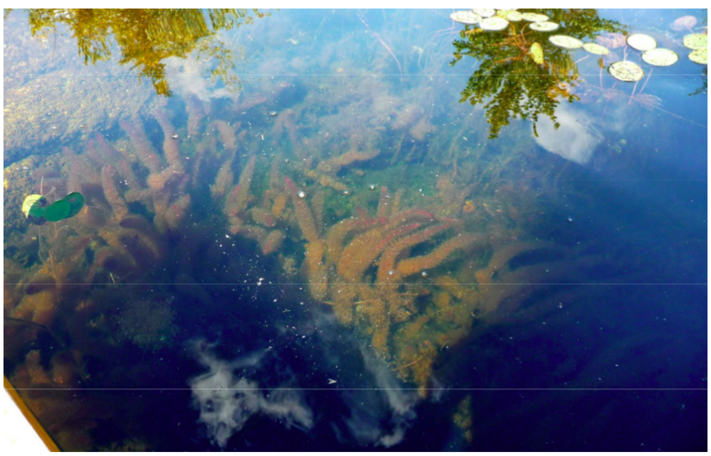
Sampling history and other studies at this lake

Pisgah Reservoir was not cored in the 1991–1995 EMAP sediment survey.

Risgah Reservoir was sampled by NH DES in 1982; pH was 4.0 and ANC was 0. Secchi transparency was 3.3 m, Chlorophyll-a was 7.14, plants were "common", and the lake was classified as mesotrophic.[1]

North Pond is listed as impaired as of 2010 for fish consumption, due to mercury, as are all NH lakes; a TMDL is in place.[7] It was assessed and is in "good" condition with respect to drinking water after treatment.[7]

North Round Pond, also within Pisgah State park and ~1.5 mi north of Pisgah Reservoir, was a subject of a paleolimnological study, including pollen reconstruction that identifies forest community structure through time; this same study included TIME lake Wickett Pond, MA752L.[6] North Round Pond was selected as the reference site for the study because it had the least amount of disturbance; the Pisgah area was never settled nor cleared for agriculture due to the terrain and there was no heavy logging.[6] The forests at Pisgah were moderately to severely damaged in the severe 1938 hurricane, and otherwise only periodically disturbed by natural fires, hurricanes, or blight.[6] Old-growth forest in Pisgah State Park has been the subject of study by Harvard University.[8]



Farwell's watermilfoil, from Bowman, 2009.[2]

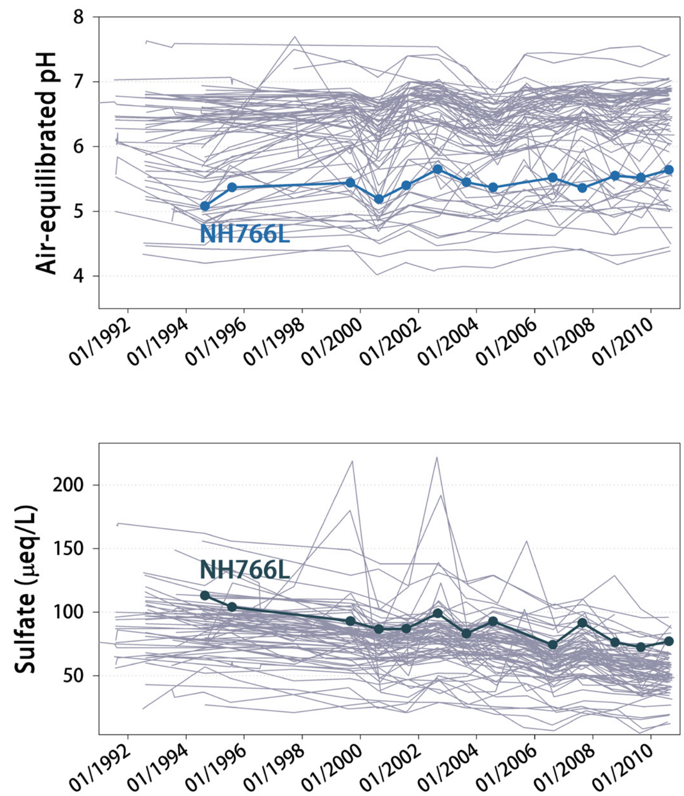


Figure NH766L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Pisgah Reservoir (thick blue line) has had among the lowest pH and highest sulfate measurements in the TIME dataset. Sulfate has steadily declined during the TIME sampling period.

References

[1] NH DES, 2009.

[2] Bowman, 2009.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] NH Fish and Game Department, 2009.

[6] Francis and Foster, 2011.

[7] US EPA, 2013.

[8] Foster, 1988.

Site access

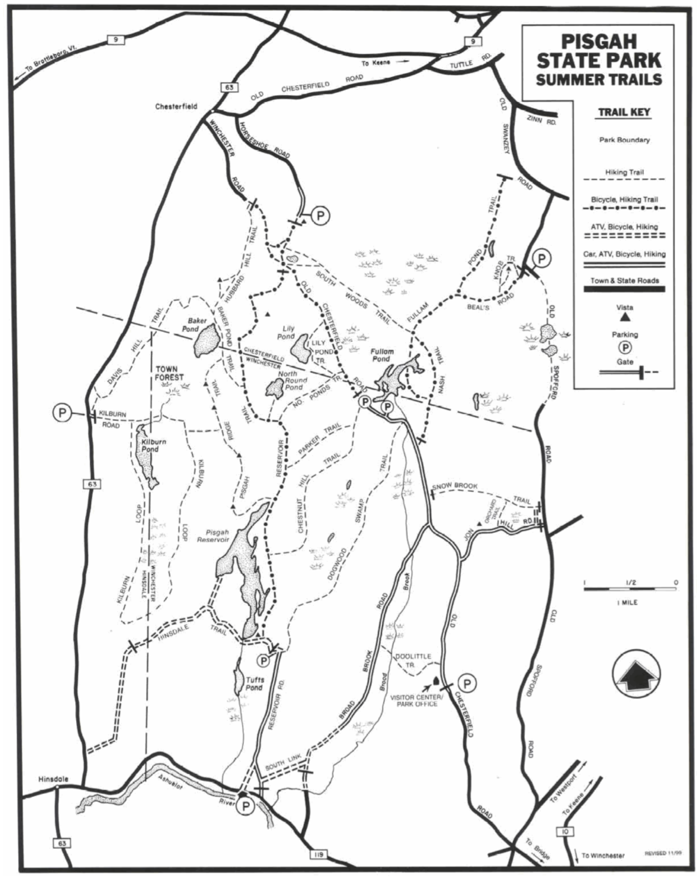
From Concord, Interstate 89 — 1hr 25 min, 66.5 mi

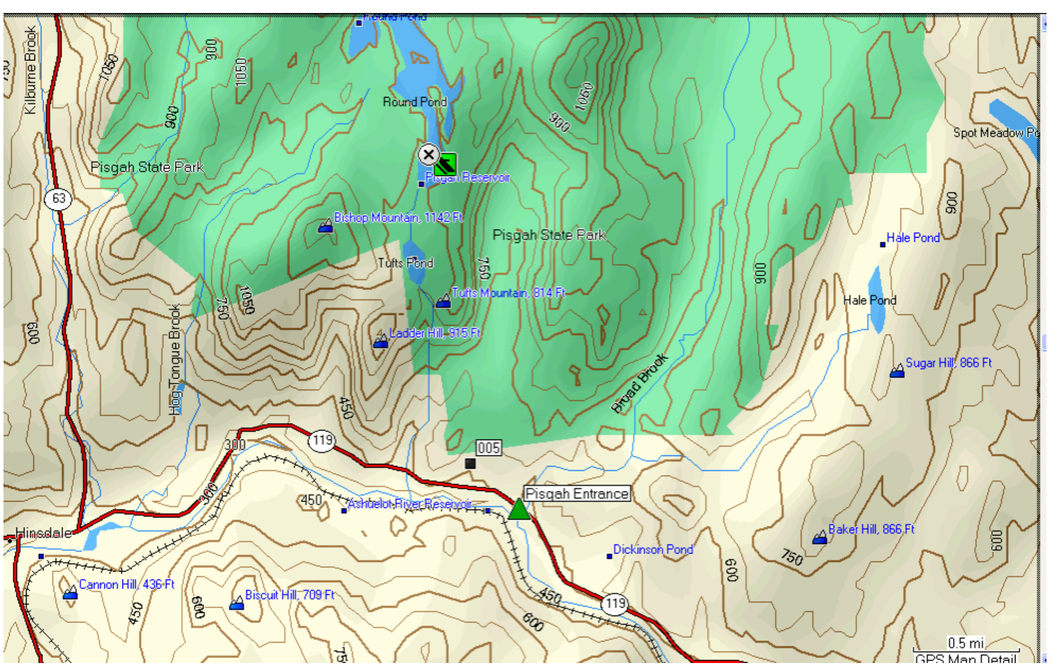
Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - **0.7 mi**
Continue straight onto NH-9 W - **41.2 mi**
Take the ramp onto NH-10 S/NH-12 S/NH-9 W - **1.5 mi**
Turn left at NH-10 S/NH-12 S - **0.5 mi**
At the traffic circle, take the 1st exit onto NH-10 S/Winchester St; Continue to follow NH-10 S - **12.4 mi**
Turn right at NH-119 W/General James Reed Hwy - **3.1 mi**
Turn right a Reservoir Rd. (May not be obvious or well marked) - **1.5 mi**
Park at gate - **END**

Launch Site Description

Although there are several trails and roads that lead to Pisgah Reservoir, the most accessible is Reservoir Rd. After driving on 1.5 miles on Reservoir Rd you will encounter a gate and parking area. Park here and hike about 0.5 miles up to Pisgah Reservoir. This leads to an adequate launch site that has several large bedrocks to launch and rinse bottles from. The small deep hole is at the southern end of the lake, near the launch and dam.

Pisgah Reservoir in 2002





Winchester,
New Hampshire

Coordinates:

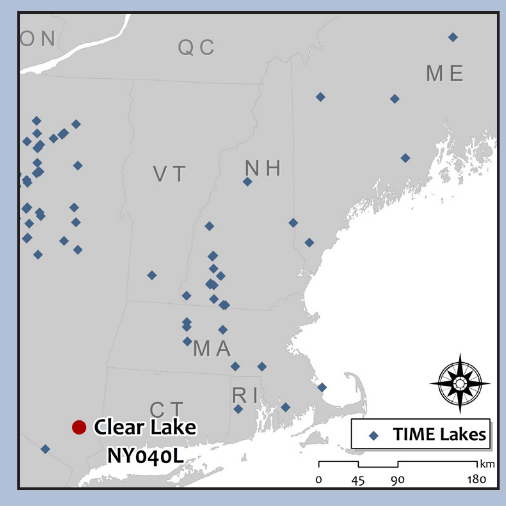
Sampling Point:
N 42.81192
W 72.44761

Launch Point:
N 42.81192
W 72.44673

Park entrance:
N 42.78852
W 72.43989

Clear Lake

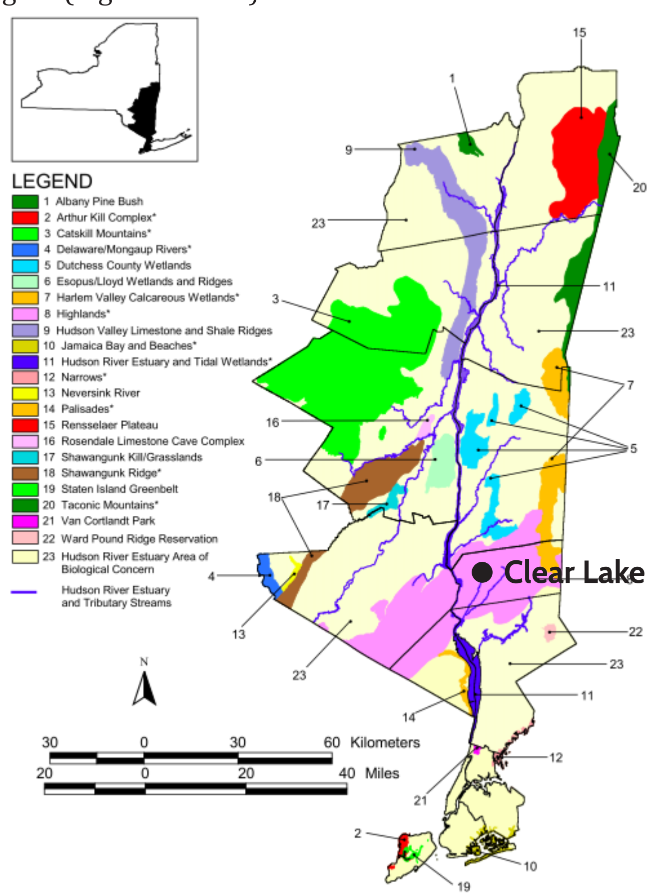
Lake ID: NY040L
Other IDs/names: NY1301-0148



Lake description

Clear Lake is located at the Agatha A. Durland Scout Reservation (previously Clear Lake Scout Reservation), which has 1,400 acres of largely undeveloped land with many campsites and miles of hiking trails, plus boating and swimming at the lake. The area around the lake is largely hardwood forest. The Scout Reservation is bordered by Clarence Fahnestock Memorial State Park (~14,000 acres) to the Northeast.

Putnam Valley is in the Hudson Highlands area of New York, less than an hour from New York City, yet this pond is quite rural in character. The large, unfragmented blocks of undeveloped land in the area (chestnut-hemlock and hemlock- northern hardwood forest) are important natural habitats listed by the NY Natural Heritage Program.[1] No specific information on Clear Lake is found in the NY DEC's Hudson River Estuary Wildlife and Habitat Conservation Framework, but there is general information about resources found in the Highlands region (Fig. NY040L.1).[2]



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1991, 1994, and 1995. Zooplankton species richness in Round Pond was in the top 75% of all EMAP lakes.[3]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Cordullidae*, *Gomphidae*, and *Libellulidae* were collected.
Fisheries: There are no known survey data on presence or extirpation, based on Maine data sources.[3] No fish data were listed in EMAP data tables.[3]
Birds: Breeding birds were not listed in EMAP data tables.[3]

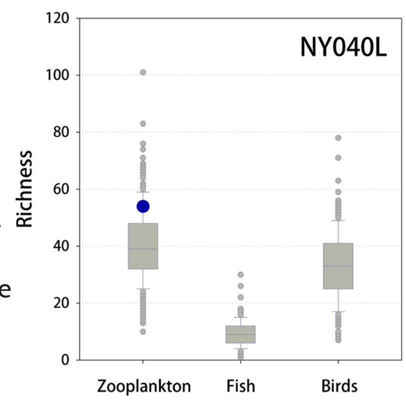


Figure NY040L.2. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).

Bathymetry

No bathymetric map is available for Clear Lake. The lake is apparently "quite deep", according to the US EPA sampling crew in 1995 field notes. In 2012, lake depth was 17 m at the sampling site. According to the camp staff, depth is 3 m around the swimming dock at the southwest lobe, and the lake reaches a depth greater than 20 m toward the center.

Figure NY040L.1. Significant biodiversity areas of the Hudson River Estuary corridor. Clear Lake is located in area 8, the Hudson Highlands region; its approximate location is noted on the map.. From Penhollow *et al.*, 2006.[2]

Table NY040L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	6.7
Watershed area (ha)	35.8
Mean depth (m)	14.85[3]
Max depth (m)	>20
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	none noted
Topography	
Minimum watershed elevation (m)	228
Maximum watershed elevation (m)	320
Mean watershed slope (degrees)	9.1
Landcover (% of total watershed)	
Open water	20.1
Developed, open space and low-intensity (<50% impervious)	4.5
Deciduous forest	64.6
Evergreen forest	6.3
Wetlands	5.0
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Paragneiss and schist	

Table NY040L.2. Long-term chemistry for Clear Lake, 1991-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.49	0.39	17
ClpH	pH units	6.54	0.54	12
ANC	$\mu eq \cdot L^{-1}$	32.4	27.8	17
DOC	$mg \cdot L^{-1}$	2.20	0.34	17
Cond	$\mu S \cdot cm^{-1}$	29.2	1.7	17
Color*	Pt-Co units	2|6	2|2	12|5
Ca^{2+}	$\mu eq \cdot L^{-1}$	117.4	6.6	17
Mg^{2+}	$\mu eq \cdot L^{-1}$	48.5	2.6	17
K^+	$\mu eq \cdot L^{-1}$	12.8	1.1	17
Na^+	$\mu eq \cdot L^{-1}$	55.4	4.3	17
Al (Total)	$\mu g \cdot L^{-1}$	13.6	9.8	16
SO_4^{2-}	$\mu eq \cdot L^{-1}$	141.7	28.3	17
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	17
Cl^-	$\mu eq \cdot L^{-1}$	45.1	2.2	17
SiO_2	$mg \cdot L^{-1}$	0.29	0.33	11
Total P	$\mu g \cdot L^{-1}$	4.0	2.7	11
Total N	$\mu g \cdot L^{-1}$	172	47	14

* Color is displayed as True|Apparent

Site disturbance & considerations

- Check in at the Scout Camp prior to sampling.

Clear Lake from the air. Photo: G. Cooper, May 2002. http://www.wpcbsa.org/Facilities/Durland

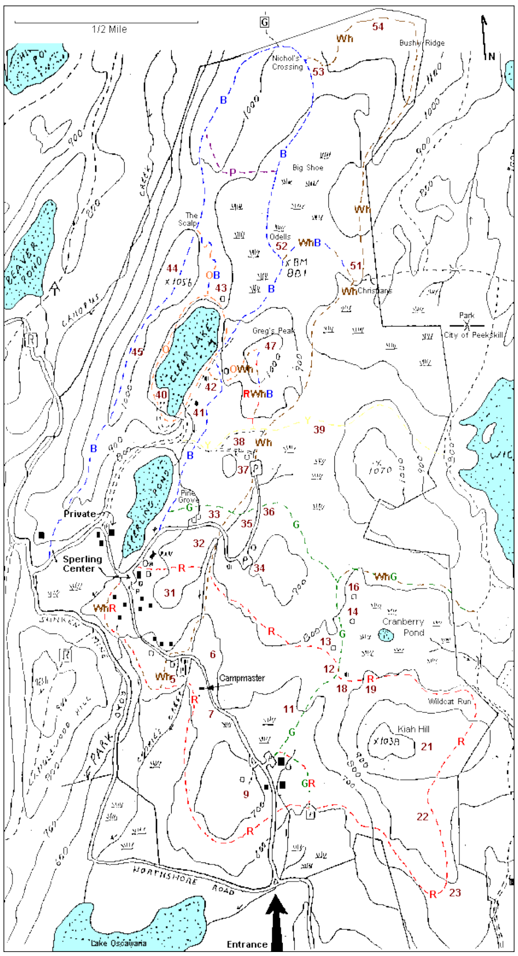
Clear Lake, near the launch site, in 2002.

Photos: C. Schmitt

Sampling history and other studies at this lake

Clear Lake was cored in 1991 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[3] Based on the EMAP core at Clear Lake, diatom-inferred pH was 7.48 in the bottom (pre-1850) section, and 5.23 in the top (recent) section.[3]

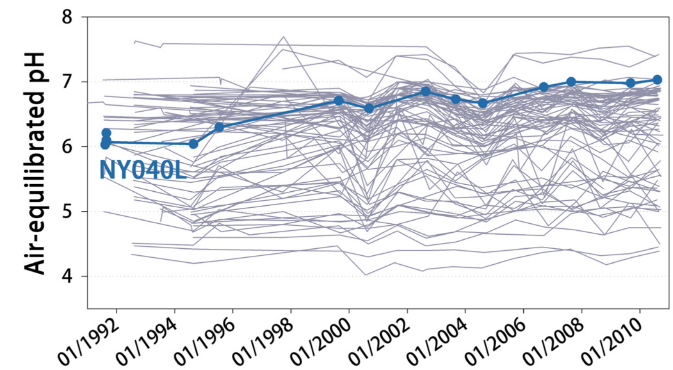
No data on assessment are listed in EPA Waters (Clear Lake is listed together with Mud Lake, to the southwest of Clear Lake).[5] No other study data were located.



Trail map for the vicinity of Clear Lake, revised 1997.

Note: Most of this map is private property. Possession of this map does not imply right of access. Permission must be obtained before entering Scout property.

http://www.wpcbsa.org/Facilities/Durland



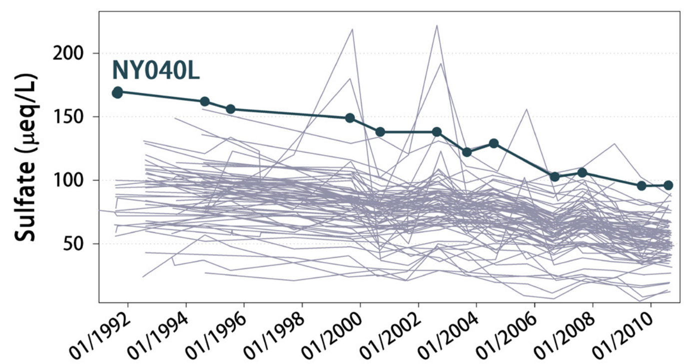


Figure NY040L.3. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Clear Lake (thick blue line) has had steadlily increasing pH and declining sulfate through the project period; sulfate remains among the highest in the TIME dataset but it has been reduced significantly.

References

[1] NY Natural Heritage Program, 2013.

[2] Penhollow *et al.*, 2006.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] US EPA, 2013.

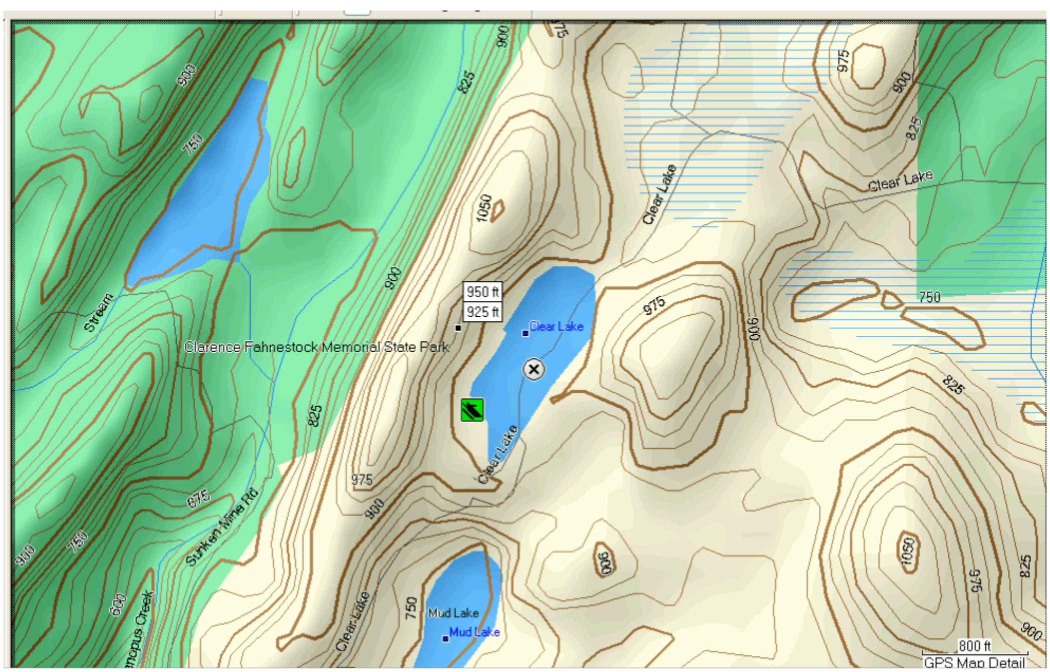
Site access

From Little Cedar Pond 1 hr, 40 mi

Head south on Sterling Mine Rd toward County Rd 84/Long Meadow Rd - **0.1 mi**
Sharp left at County Rd 84/Long Meadow Rd - **2.7 mi**
Turn left at County Rd 84/Long Meadow Rd - **2.5 mi**
Turn right at New York 17A E - **1.4 mi**
Turn left toward NY-17 N - **0.2 mi**
Turn left at NY-17 N - **6.6 mi**
Turn right to merge onto US-6 E - **6.4 mi**
At the traffic circle, take the 3rd exit onto theUS-6 E ramp to Bear Mountain - **0.5 mi**
Merge onto US-6 E/Palisades Interstate Pkwy - **2.5 mi**
At the traffic circle, take the 2nd exit ontoUS-202 E/US-6 E; Partial toll road - **0.6 mi**
Turn left at New York 9D N - **7.9 mi**
Turn right at Peekskill Rd - **0.5 mi**
Turn right at NY-301 E/Main St - **4.5 mi**
Turn right at Dennytown Rd - **0.7 mi**
Take the 2nd left onto Clarence Fahnestock Memorial St Park/Sunken Mine Rd - **2.0 mi**
Slight left at Clear Lake Rd - **0.7 mi**
Turn left to stay on Clear Lake Rd - **371 f - END**

Launch Site Description

Go past a gate with house on the right, uphill to the Sperling Center. Take a left just before the Sperling Center lot. Pass a house on the right, continue up the gravel road that winds around the lake. This ends at the pavillion at site 40, where you can easily launch and sample.



Putnam Valley, New York

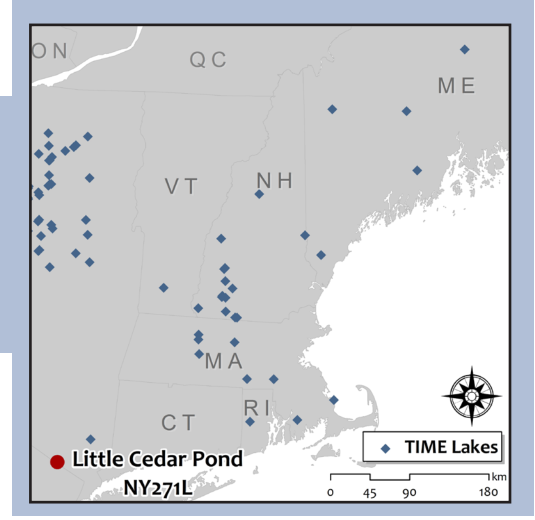
Coordinates:

Sampling Point:
N 41.42904
W 73.84075

Launch Point:
N 41.42818
W 73.84247

Little Cedar Pond

Lake ID: NY271L
Other IDs/names: NY1501-0067

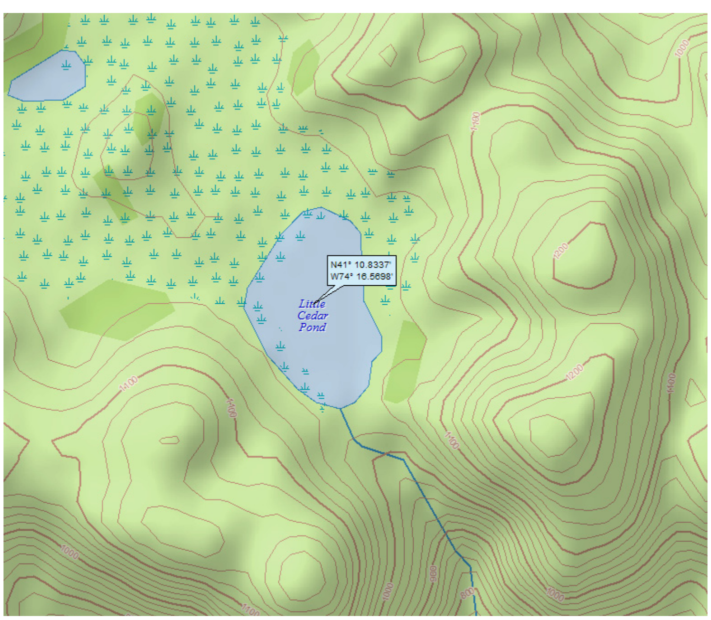


Lake description

Little Cedar Pond is within Sterling Forest State Park (21,935 acres), ~35 miles northwest of New York City. Because many parks in the area cross the NY-NJ state line, Sterling Forest State Park is part of the interstate Palisades Parks Conservancy. The pond is small and darkly colored, owing to its wetland setting.

The area of Little Cedar Pond includes two important wetland types: a shrub bog and an inland Atlantic white cedar swamp. The New York State Natural Heritage Program, in conjunction with The Nature Conservancy, recognizes Little Cedar Pond as a large (61 ha) inland Atlantic white cedar swamp in excellent condition, the best example in the NY-NJ highlands area (and possibly in the world).[1]

Atlantic white cedar (*Chamaecyparis thyoides*) swamps have a restricted distribution inland, away from the coast. According to the US Fish and Wildlife Service, "These swamps are dominated by Atlantic white cedar, sometimes grading into a hardwood-conifer swamp with red maple, black gum, and eastern hemlock, and a shrub layer dominated by winterberry, smooth winter-berry (*Ilex laevigata*), rhododendron, highbush blue-berry, swamp azalea, and sweet pepperbush (*Clethra alnifolia*), and ground covers of ferns and Sphagnum mosses."[1] Little Cedar Pond is a prime example of this natural community type.



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1992, 1994, and 1995. Zooplankton species richness in Round Pond was slightly greater than the median for all EMAP lakes.[2]
Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury re-search.[3] Individuals of the families *Corduliidae*, *Gomphi-dae*, and *Libellulidae* were collected.
Fisheries: Only one species fish data was listed in EMAP data tables from 1992 sampling, though two species were listed in the mercury sampling dataset.[2]
Birds: Breeding birds richness was low as compared to other EMAP lakes in the 1992 survey.[2] There is a Bird Conservation Area within Sterling forest, and richness in the area is most likely fairly high.

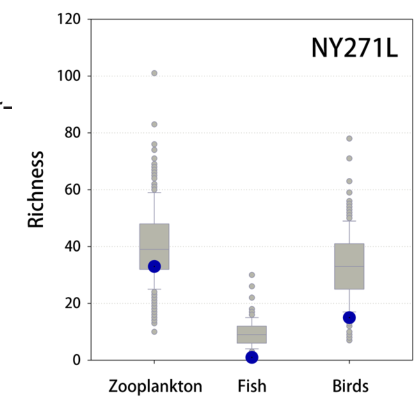


Figure NY271L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[2] (gray box plot) and for this pond (blue dots).

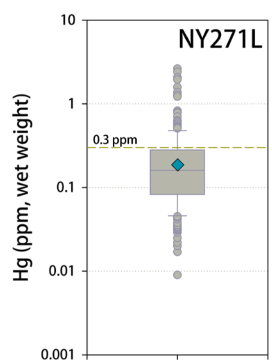


Figure NY271L.2. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[2] (gray box plot) and for this lake (blue dot), sampled in 1992. Little Cedar's yellow perch (*Perca flavescens*) and brown bullhead (*Ameiurus nebulosus*) samples had 0.186 ppm of Hg, near the median across all EMAP lakes sampled. The US EPA advisory level is shown (0.3 ppm).

Bathymetry

No bathymetric map is available for Little Cedar Pond. Depth at the sampling site in 2012 was ~4 m.

Table NY271L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	8.4
Watershed area (ha)	181.6
Mean depth (m)	1.67[2]
Max depth (m)	>4
Drainage class	drainage
Number of inlets	0
Number of outlets	1
Flow alteration	beaver dam
Topography	
Minimum watershed elevation (m)	304
Maximum watershed elevation (m)	385
Mean watershed slope (degrees)	5.9
Landcover (% of total watershed)	
Open water	5.8
Deciduous forest	62.0
Evergreen forest	0.0
Mixed forest	3.2
Wetlands	29.0
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology	
Paragneiss and schist	

Table NY271L.2. Long-term chemistry for Little Cedar P., 1992-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	4.74	0.27	16
ClpH	pH units	4.72	0.27	16
ANC	$\mu eq \cdot L^{-1}$	-12.7	19.1	16
DOC	$mg \cdot L^{-1}$	17.62	5.56	16
Cond	$\mu S \cdot cm^{-1}$	33.9	6.9	16
Color*	Pt-Co units	180|182	43|81	10|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	101.4	15.9	16
Mg^{2+}	$\mu eq \cdot L^{-1}$	45.0	8.3	16
K^+	$\mu eq \cdot L^{-1}$	6.5	3.0	16
Na^+	$\mu eq \cdot L^{-1}$	64.7	6.3	16
Al (Total)	$\mu g \cdot L^{-1}$	175.8	42.5	16
SO_4^{2-}	$\mu eq \cdot L^{-1}$	113.4	42.1	16
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	16
Cl^-	$\mu eq \cdot L^{-1}$	37.0	3.7	16
SiO_2	$mg \cdot L^{-1}$	3.13	1.91	14
Total P	$\mu g \cdot L^{-1}$	15.7	2.7	9
Total N	$\mu g \cdot L^{-1}$	472	117	13

* Color is displayed as True|Apparent

Site disturbance & considerations

- Sterling Forest State Park is open dawn to dusk. Consult the Park's Web site for other details; http://nysparks.com/parks/74/details.aspx
- Hunting is allowed in the Park; wear blaze orange in season. Bear have been observed in the Park.
- The pond is noted as a "Wilderness/wildlife rehabilitation area".

On the trail to Little Cedar, 2002. Photo: S. Schmitt.

Sampling history and other studies at this lake

Little Cedar Pond was cored in 1992 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[2] Based on the EMAP core at Little Cedar Pond, diatom-inferred pH was 6.91 in the bottom (pre-1850) section, and 5.82 in the top (recent) section.[2]

Other studies at Little Cedar Pond have focused on the exemplary inland Atlantic white cedar swamp community. One study quantified vegetation of the bog mat and bog forest surrounding Little Cedar Pond by sampling vegetation monthly from April–September, 1979.[4] The author found 100% frequency and 90% cover of Atlantic white cedar (*Chamaecyparis thyoides,* also called southern white cedar) in the bog forest. The bog mat contained leatherleaf and sheep laurel as its most common flora. The publication provides detailed plant lists along several transects around the pond-wetland complex.[4]

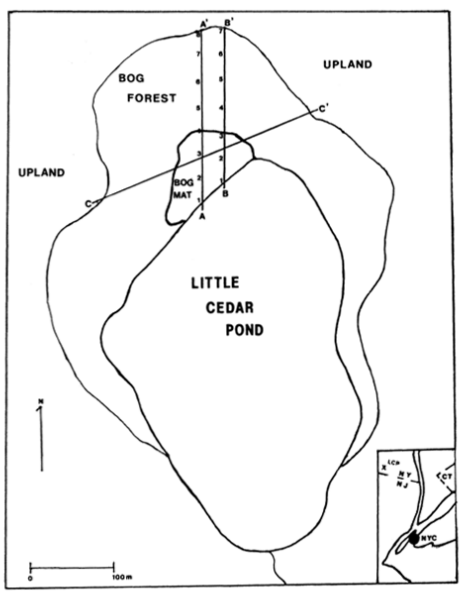


Figure NY271L.3. Sketch map of Little Cedar Pond and surrounding wetlands, from Lynn, 1984.[4]

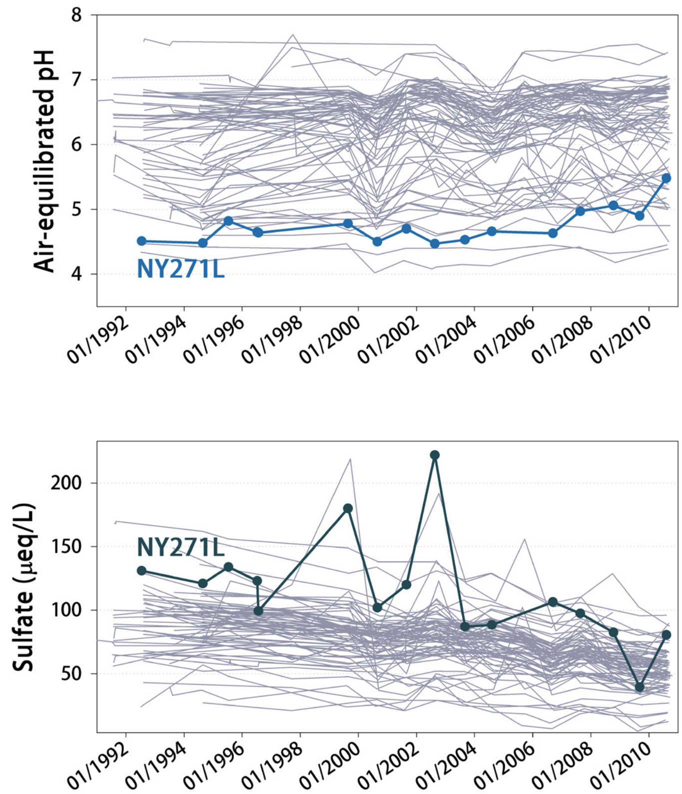


Figure NY271L.4. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Little Cedar Pond (thick blue line) has had among the lowest pH and highest sulfate measurements in the TIME dataset. Because of its bog-like setting, the pond is most certainly naturally acidic.

References

[1] US FWS, 1997.

[2] US EPA, 2012.

[3] Nelson *et al.*, 2011.

[4] Lynn, 1984.

Site access

From NH-16S 4 hrs 30 mins, 267.6 mi

Take the exit onto I-95 S toward Hampton/Boston Partial toll road - **16.5 mi**
Slight right at I-495 S - **55.2 mi**
Take exit 25B to merge onto I-290 W toward Worcester - **20.2 mi**
Take exit 7 for I-90/Mass. Pike Partial toll road - **0.8 mi**
Follow signs for I-90 W/Springfield/Albany and merge onto I-90 W Toll road - **11.8 mi**
Take exit 9 to merge onto I-84 W towardUS-20/Hartford/New York City Partial toll road - **109 mi**
Take exit 20 for I-684 toward NY-22/White Plains/Pawling - **0.1 mi**
Keep left at the fork and merge onto I-684 S - **10.9 mi**
Take exit 5 toward NY-117 - **0.9 mi**
Keep left at the fork - **17.5 mi**
Take the I-87 W/I-287 W ramp to Albany/New York City - **0.6 mi**
Follow signs for I-87 N/I-287 W/Albany/Tappan Zee Bridge and merge onto I-287 W Partial toll road - **18.7 mi**
Continue onto I-87 N Toll road - **1.5 mi**
Take exit 15A to merge onto NY-17 N Partial toll road - **0.2 mi**
Turn left at NY-17 N/Orange Turnpike - **1.4 mi**
Slight right toward Co Rd 72/Sterling Mine Rd - **0.3 mi**
Continue straight onto Co Rd 72/Sterling Mine Rd - **2.7 mi**
Turn right at County Rd 84/Long Meadow Rd - **2.7 mi**
Slight left at Sterling Mine Rd - **0.1 mi - END**

Launch Site Description

Park at the gate at north end of Blue Lake and hike up the road ~1 mile. Bear right at the first fork after the lake. After about 0.5 miles, a white-blazed trail goes off to the right; stay straight/left on the main road. After a "Road Closed Ahead" sign there is a clearing. Take the road to the right with a cable across it and a "Closed Area" sign. There are also some large logs piled up here. Hike up the washed-out gravel road to the pond. Use inflatable pack boat.

Sloatsburg, New York

Coordinates:

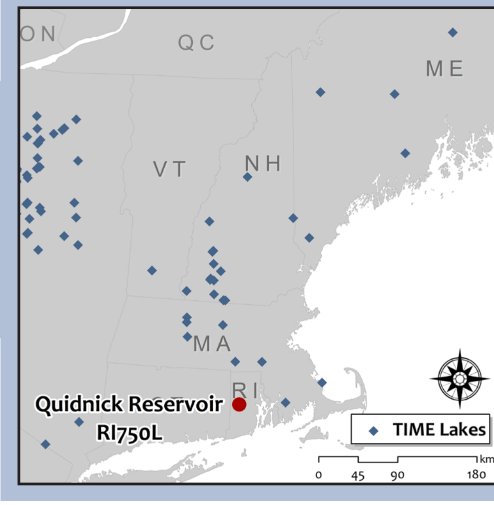
Sampling Point:
N 41.17954
W 74.27603

Launch Point:
N 41.17862
W 74.27516

Quidnick Reservoir

Lake ID: RI750L

Other IDs/names: RI0006013L-04



Lake description

Owned by the Quidnick Reservoir Association, the Quidnick Reservoir, with 171 acres of surface area, was constructed in 1875 (previously known as Quidnick Pond)[1] for recreational purposes. The dam is at the northern end of the lake. The perimeter of the reservoir has a mostly forested shore line with some residential housing. The eastern shore is the location of the Westwood YMCA camp, a day camp with a beach from which to launch. The lake is oligotrophic.

According to the Critical Lands Analysis of Rhode Island, there are wetlands adjacent to the southwest portion of the lake, and a wellhead protection area on the eastern shore.[2] Terrain around the pond is relatively flat, with a hardwood-dominated forest.

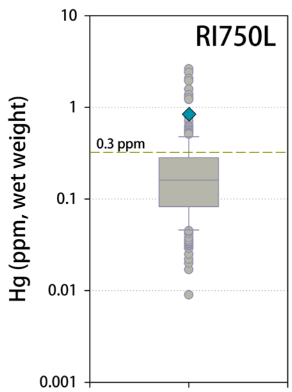


Figure RI750L.1. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot), sampled in 1994. Quidnick's smallmouth bass (*Micropterus dolomieu*) samples had 0.780 ppm of Hg, exceeding the US EPA advisory level of 0.3 ppm.

Biota

Zooplankton: Sampled in 1994 as part of EMAP, zooplankton species richness in Quidnick Reservoir was slightly less than the median for all EMAP lakes.[3]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[4] Individuals of the families *Aeshnidae*, *Corduliidae*, and *Libellulidae* were collected.

Fisheries: Fish species richness was near the median across all EMAP lakes.[3]

Birds: Breeding bird species richness was slightly greater than the 75th percentile for all EMAP lakes sampled.[3]

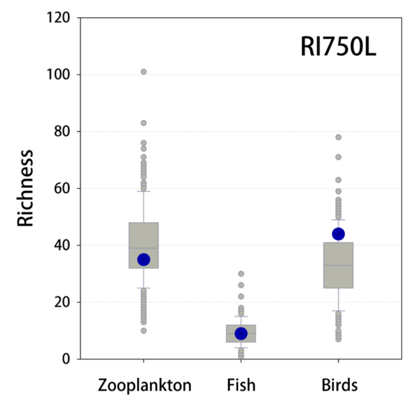
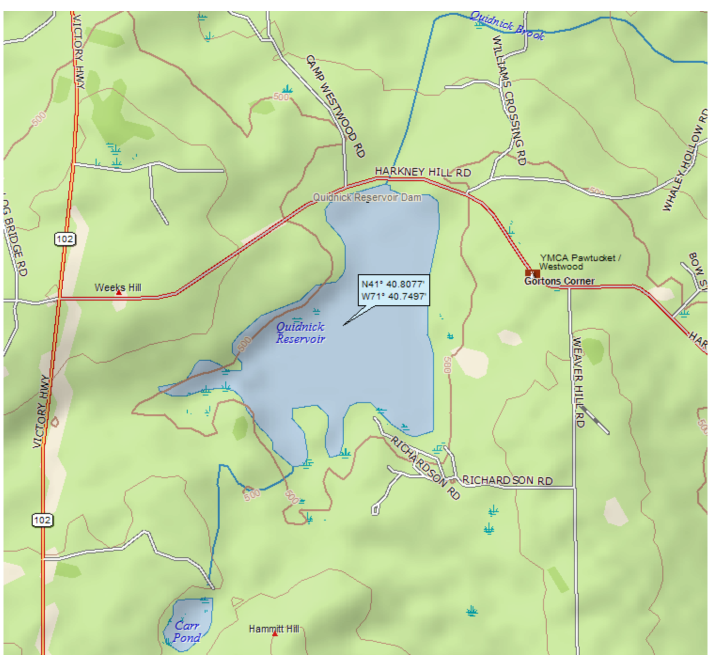


Figure RI750L.2. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).



Bathymetry

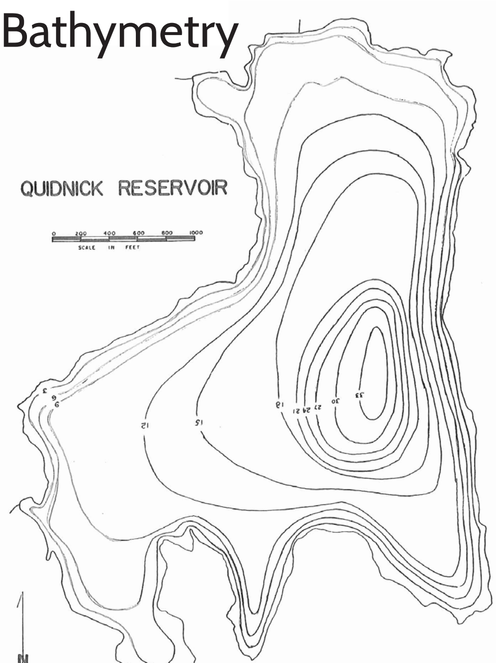


Table RI750L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	70.2
Watershed area (ha)	616.6
Mean depth (m)	4.78[3]
Max depth (m)	10
Drainage class	reservoir
Number of inlets	1
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	141
Maximum watershed elevation (m)	184
Mean watershed slope (degrees)	2.8
Landcover (% of total watershed)	
Open water	12.1
Developed, open space and low-intensity (<50% impervious)	7.0
Developed, medium to high density (≥50% impervious)	0.7
Deciduous forest	59.6
Evergreen forest	6.4
Mixed forest	1.5
Shrub & Herbaceous	2.5
Agriculture (hay, cultivated)	1.8
Wetlands	16.8
Mean Impervious surface (% of total watershed)	1.7
Bedrock Geology	
Granitic rocks	

Table RI750L.2. Long-term chemistry for Quidnick, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.72	0.18	12
ClpH	pH units	6.46	0.19	12
ANC	$\mu eq \cdot L^{-1}$	51.2	9.1	12
DOC	$mg \cdot L^{-1}$	3.48	0.34	12
Cond	$\mu S \cdot cm^{-1}$	99.3	15.6	12
Color*	Pt-Co units	13|25	4|9	6|6
Ca^{2+}	$\mu eq \cdot L^{-1}$	136.4	13.7	12
Mg^{2+}	$\mu eq \cdot L^{-1}$	55.4	5.0	12
K^+	$\mu eq \cdot L^{-1}$	19.3	2.3	12
Na^+	$\mu eq \cdot L^{-1}$	595.4	95.2	12
Al (Total)	$\mu g \cdot L^{-1}$	26.8	30.0	12
SO_4^{2-}	$\mu eq \cdot L^{-1}$	97.6	10.3	12
NO_3^-	$\mu eq \cdot L^{-1}$	<1.0	<1.0	12
Cl^-	$\mu eq \cdot L^{-1}$	655.3	121.5	12
SiO_2	$mg \cdot L^{-1}$	1.79	0.77	10
Total P	$\mu g \cdot L^{-1}$	4.3	2.6	5
Total N	$\mu g \cdot L^{-1}$	193	52	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- When camp is in session, check with YMCA staff.
- High salt concentrations are likely due to coastal proximity.

Quidnick Reservoir. Photo: Katie DeGoosh, RI DEM,

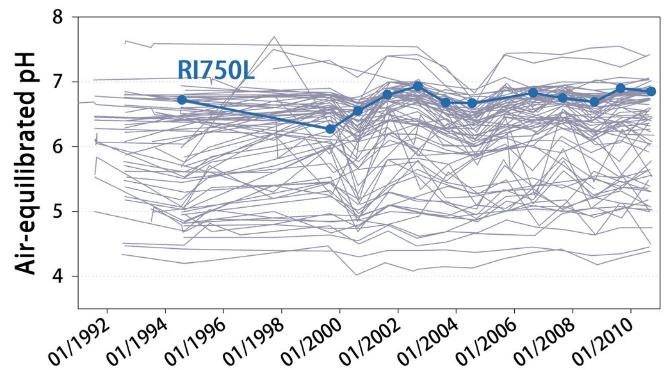
Sampling history and other studies at this lake

Quidnick Reservoir was cored in 1994 as part of an EMAP sediment survey that evaluated the top and bottom sections of cores for diatom assemblages, from which to infer pH, Cl, and other metrics.[5] Based on the EMAP core at Quidnick Reservoir, diatom-inferred pH was 7.23 in the bottom (post-1850) period, and 7.37 in the top (recent) section.[5]

Quidnick Reservoir is listed as impaired since 2000 for fish consumption, due to mercury; a TMDL is in place.[5] It was assessed and is in "good" condition with respect to both primary and secondary contact recreation.[5]

URI Watershed Watch sampled Quidnick for parameters related to trophic status; Quidnick typically had Secchi transparency >4 m and low Cholorphyll-a, phosphorus, and nutrient concentrations, indicating that the lake is oligotrophic (Fig. RI750L.3).[6]

To begin developing numeric nutrient criteria for freshwater lakes, the RI DEM sampled Quidnick Reservoir (along with 71 other lakes) twice in 2011: once in spring/early summer and once late summer/early fall. Each visit had a grab sample for true color and a water column profile (temperature, DO, Specific Conductivity, and pH). They also did a tour of the lake mapping macrophytes as to quantify percent cover of emergent, floating, and submergent plants. Any future sampling would depend on volunteer monitoring; RI DEM isn't currently planning any resampling.[7]



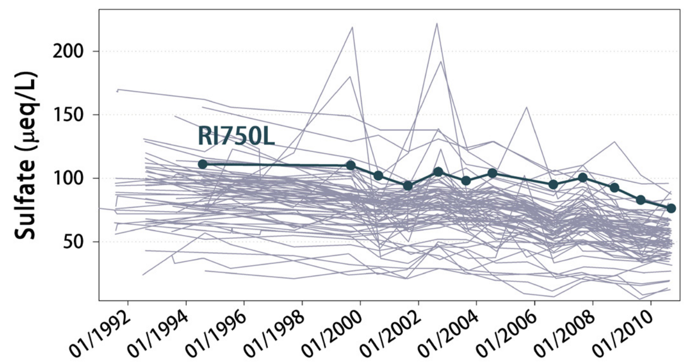


Figure RI750L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Quidnick Reservoir (thick blue line) has had among the highest pH and highest sulfate concentrations in the TIME dataset. Sulfate has steadily declined through the period of record.

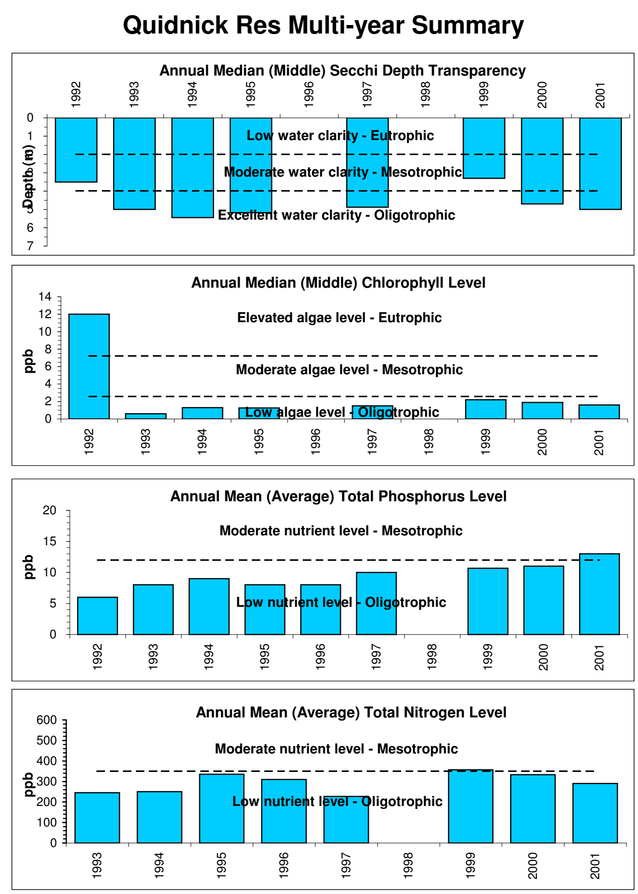


Figure RI750L.3. URI Watershed Watch data for Quidnick Reservoir.[6]

References

[1] RI Historical Preservation Commission, 1978.

[2] McCann et al, 2001.

[3] US EPA, 2012.

[4] Nelson *et al.*, 2011.

[5] US EPA, 2013.

[6] URI Watershed Watch, 2013.

[7] Sawyers, Jane, RI DEM, pers comm., February 2013.

Site access

From I- 95

11 min, 7.7 mi

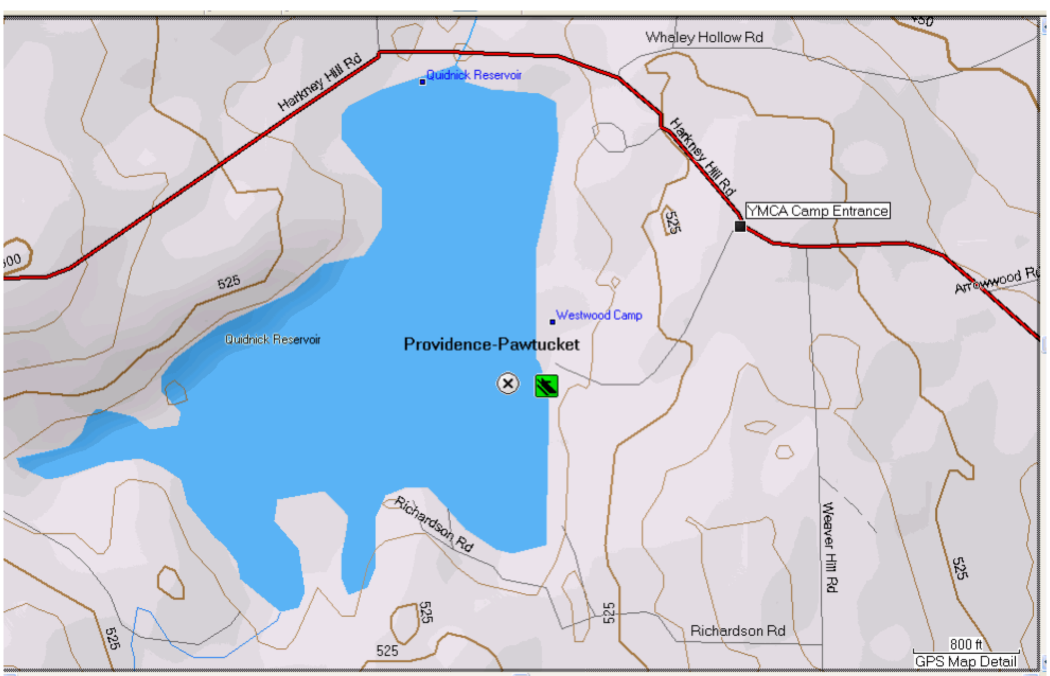
Head west on Exit 5B toward RI-102 N/Victory Hwy - **0.2 mi**
Merge onto RI-102 N/Victory Hwy - **5.6 mi**
Turn right at RI-118 E/Harkney Hill Rd - **1.5 mi**
Turn right at Westwood YMCA Camp entrance - **0.4 mi**
Park toward end of road near launch (Talk with camp staff if available about where to park and launch) - **END**

Launch Site Description

If sampling during June, July or August, the camp will probably be in session and the YMCA staff will let you know where to launch. If the camp is not in session and the staff are not there, you can launch from the concrete stairs that lead into the reservoir. The stairs are located next to a concrete jetty/ boat dock left of the roped-off swimming area.

Launch area, 2002

Quidnick Reservoir, 2002



Coventry, Rhode Island

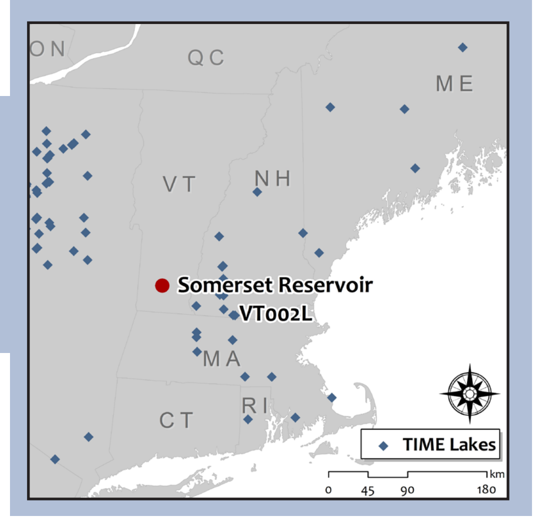
Coordinates:

Sampling Point:
N 41.67913
W 71.67542

Launch Point:
N 41.67907
W 71.67435

Somerset Reservoir

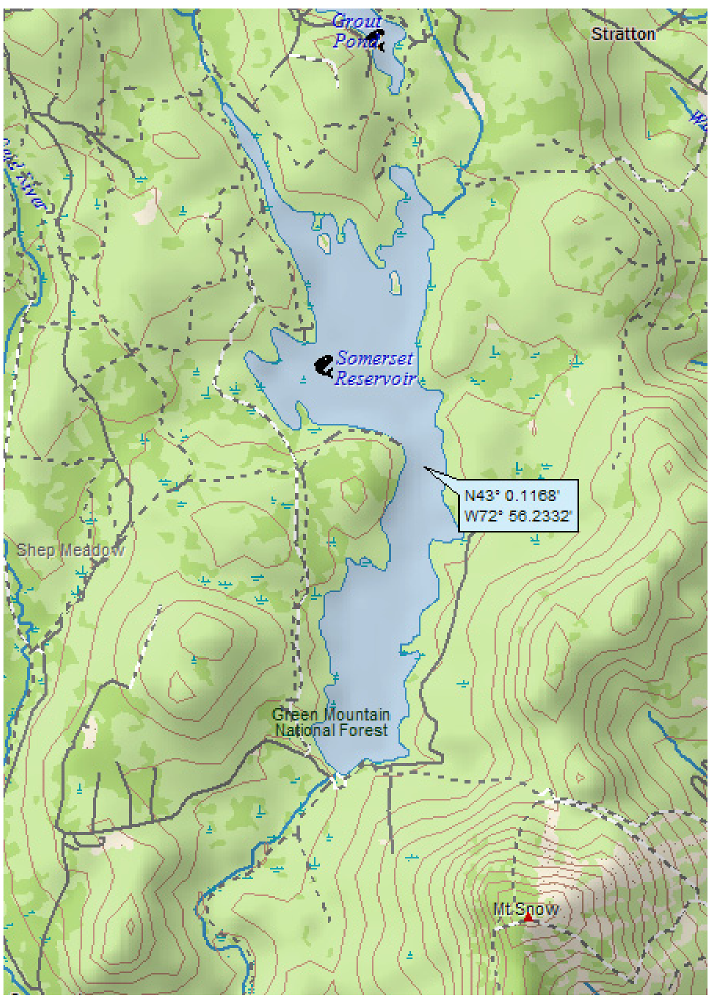
Lake ID: VT002L
Other IDs/names: VT12-03L02



Lake description

Somerset Reservoir is the northernmost in a series of 10 impoundments from VT to MA collectively knows as the Deerfield River project. The dam was constructed in 1913 for hydropower use at the south end of the lake.[1] Somerset Reservoir is remote, though heavily used for recreation; it sits at the end of a nine mile gravel road in Somerset and Stratton. It is sensitive to acidification. The lake is mesotrophic and it does stratify.[2]

The Reservoir is five miles long, 1568 acres in size and has 12 islands and approximately 16 miles of coastline. The Reservoir is wholly owned by the Trans Canada power corporation; the shoreline is undeveloped and surrounded by 15,000 acres of forest. Many ponds, streams, and wetlands are within the watershed. A large tussock sedge marsh, black spruce bogs, and a marsh and fen (on the eastern shore) are part of the diverse set of wetlands near the lake. Grout Pond (86 acres) lies to the north of the Reservoir.[3]



Biota

Zooplankton: As part of EMAP, zooplankton were sampled in 1995. Zooplankton species richness in Somerset Reservoir Pond was slightly greater than the median for all EMAP lakes.[4]

Invertebrates: Dragonfly larvae (Odonata: Anisoptera) were sampled in August 2012 as part of mercury research.[5] Individuals of the family Aeshnidae were collected.

Fisheries: A Vermont report on water quality in the Deerfield River Basin lists seven species (smallmouth bass, rock bass, pumpkinseed, chain pickerel, brown bullhead, yellow perch, stocked brook trout) in Somerset Reservoir.[6] No fish data were listed in EMAP data tables.[4]

Birds: Breeding birds were not listed in EMAP data tables.[4] However, the lake is the site of Vermont's only loon nesting pair and water levels are held "to within three inches of nesting loons", according to TransCanada Hydro.[7]

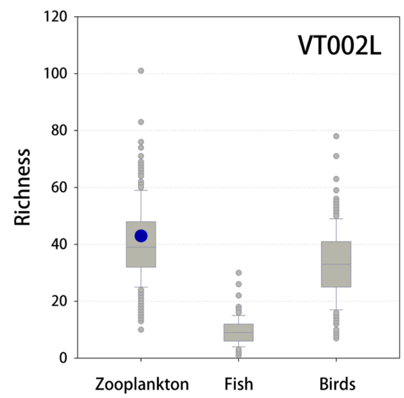


Figure VT002L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake, Round Pond (blue dots).

Bathymetry

No bathymetric map is available for Somerset Reservoir. The US Geological Survey reports monthly statistics for several reservoirs in Vermont, including Somerset. In December 2012, the reservoir was 84% full with 2,090,000,000 ft^3.[8] In 2012, lake depth was ~20 m at the sampling site.

Table VT002L.1: Watershed and lake characteristics. Units are given in the table. Methods for determining each metric and further details are in Table 3 in the Introduction.

Morphometry & Hydrology	
Lake Area (ha)	606.6
Watershed area (ha)	6910.2
Mean depth (m)	11.04[4]
Max depth (m)	>20
Drainage class	reservoir
Number of inlets	2
Number of outlets	1
Flow alteration	dammed
Topography	
Minimum watershed elevation (m)	635
Maximum watershed elevation (m)	1203
Mean watershed slope (degrees)	5.8
Landcover (% of total watershed)	
Open water	9.6
Developed, open space and low-intensity (<50% impervious)	0.4
Developed, medium to high density (≥50% impervious)	0.5
Deciduous forest	58.4
Evergreen forest	13.9
Mixed forest	12.3
Shrub & Herbaceous	0.6
Wetlands	5.1
Mean Impervious surface (% of total watershed)	0.0
Bedrock Geology (% of total watershed)	
• Paragneiss and schist (74%) • Cambrian eugeosynclinal (26%)	

Table VT002L.2. Long-term chemistry for Somerset Res., 1991-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

Variable	Units	Mean	Std Dev	n
EqpH	pH units	6.44	0.18	11
ClpH	pH units	6.20	0.11	11
ANC	$\mu eq \cdot L^{-1}$	26.2	9.8	11
DOC	$mg \cdot L^{-1}$	3.45	0.52	11
Cond	$\mu S \cdot cm^{-1}$	16.9	4.8	11
Color*	Pt-Co units	15|24	5|14	6|5
Ca^{2+}	$\mu eq \cdot L^{-1}$	61.7	10.9	11
Mg^{2+}	$\mu eq \cdot L^{-1}$	26.3	3.9	11
K^{+}	$\mu eq \cdot L^{-1}$	10.5	1.7	11
Na^{+}	$\mu eq \cdot L^{-1}$	42.6	19.5	11
Al (Total)	$\mu g \cdot L^{-1}$	71.5	19.7	11
SO_4^{2-}	$\mu eq \cdot L^{-1}$	61.0	14.0	11
NO_3^{-}	$\mu eq \cdot L^{-1}$	5.0	4.4	11
Cl^{-}	$\mu eq \cdot L^{-1}$	28.2	17.4	11
SiO_2	$mg \cdot L^{-1}$	2.66	1.04	10
Total P	$\mu g \cdot L^{-1}$	6.5	2.7	5
Total N	$\mu g \cdot L^{-1}$	222	104	9

* Color is displayed as True|Apparent

Site disturbance & considerations

- There are no known invasives.
- The reservoir is dammed and water levels fluctuate, though there is some limit to water level fluctuation due to loon nesting.
- Be prepared for summer traffic.

Sampling history and other studies at this lake

Somerset Reservoir was not cored in the 1991-1995 EMAP sediment survey.[4] Somerset Reservoir was assessed and is impaired due to mercury (since 1998) and pH (since 2008). Its outlet, the East Branch of the Deerfield River, is also impaired due to low pH.[8]

Somerset Reservoir is monitored by VT DEC's Monitoring, Assessment and Planning Program.[6] It is also just south of (and fed by) Grout Pond, one of Vermont Department of Natural Resource's Long Term Monitoring Lakes. Somerset Reservoir was also sampled as part of REMAP, a three-year field study of mercury in Vermont and New Hampshire freshwaters.[2]

Somerset was the subject of two petitions to the Vermont Natural Resources Board, Water Resources Panel: one in 1994 to prohibit use of personal watercraft, which was adopted; and one in 2004 to limit motor boating, which was denied in 2005.[1,3] The petitions and decisions provide information and several aerial photos of the reservoir. The 2004 petition filing documentation claims that the reservoir is surrounded by some of the most diverse wetland types in the Green Mountain region.[3]

Somerset Reservoir, 2003. Photo: Mitchell Center.

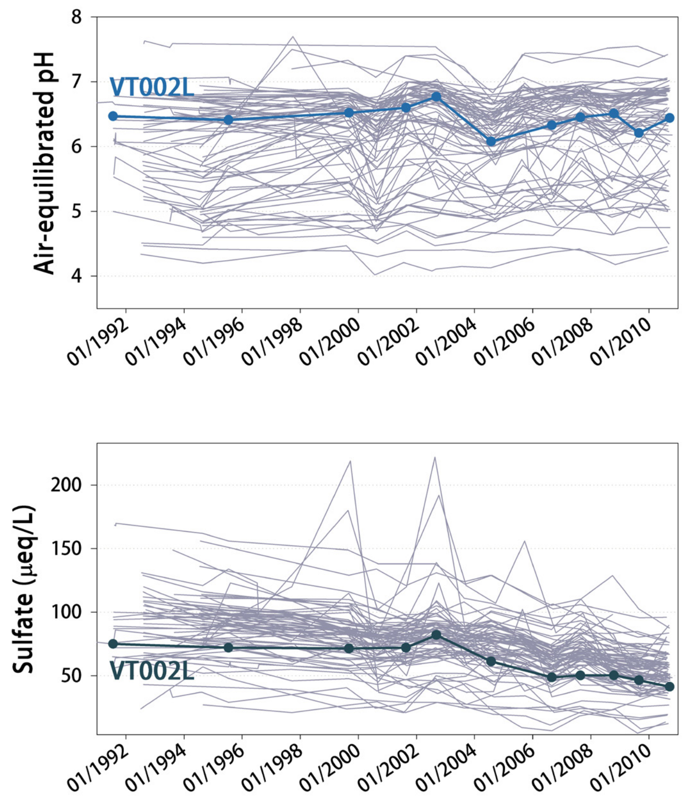


Figure VT002L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). Somerset Reservoir (thick blue line) has moderately low pH and sulfate measurements among those in the TIME dataset. Sulfate has declined steadily throughout the project.

References

[1] State of Vermont Water Resources Board, 1994.

[2] Kamman *et al.*, 2004.

[3] Gebb, 2005.

[4] US EPA, 2012.

[5] Nelson *et al.*, 2011.

[6] VT DEC, 2012.

[7] TransCanada, 2009.

[8] US EPA, 2013.

Photo date: August, 2012 • Credit: A. Baumann

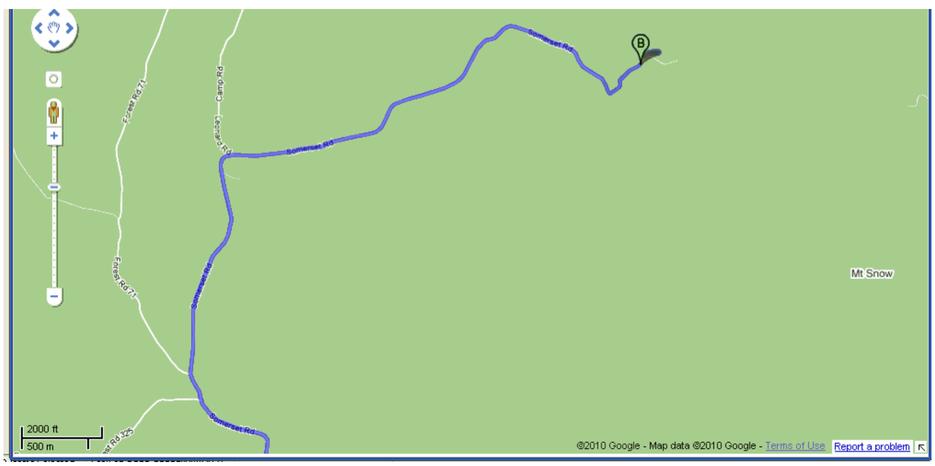
Site access

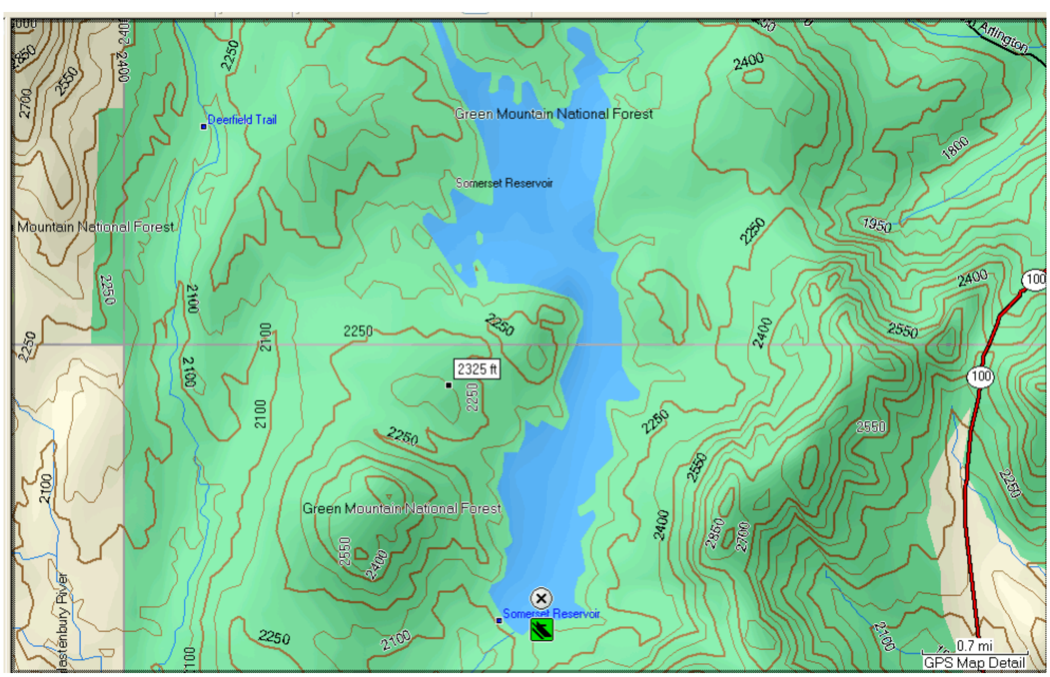
From I-89 — 2 hrs 30 mins, 102.4 mi

Head southwest on I-89 N toward Exit 1 - 8.0 mi
Take exit 5 on the left for US-202 W/NH-9 toward Henniker/Keene - 0.4 mi
Continue straight - 0.3 mi
Continue straight onto NH-9 W/U.S. 202 W; Continue to follow NH-9 W - 41.2 mi
Take the ramp onto NH-10 S/NH-12 S/NH-9 W - 1.5 mi
Turn right at NH-9 W/Franklin Pierce Hwy; Entering Vermont - 14.5 mi
Continue onto Chesterfield Rd - 0.2 mi
At the traffic circle, continue straight onto Chesterfield Rd/State Route 9 - 482 ft
Merge onto I-91 S via the ramp to US-5 S/US-9 W - 2.8 mi
Take exit 2 for VT-9 W toward Brattleboro/Bennington - 0.5 mi
Turn right at VT-9 W/Western Ave; Continue to follow VT-9 W - 23.4 mi
Turn right at National Forest 71/Somerset Rd; Continue to follow Somerset Rd - 6.2 mi
Turn right onto to Somerset Rd (stay on Somerset Rd till boat launch) - approx. 3.4 mi
Park at boat Launch - END

Launch Site Description

The put in for the Somerset is gravel ramp, challenging for trailering a boat but appropriate for canoe/kayak use. The parking areas are small and grassy with ~20 vehicle spaces. If too crowded, head down the shoreline a bit.





Somerset, Vermont

Coordinates:

Sampling Point:
N 42.97584
W 72.94497

Launch Point:
N 42.97398
W 72.94496

References

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