Lake Site Assessments
US EPA TIME-New England Lakes

Prepared by:
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Contributors:
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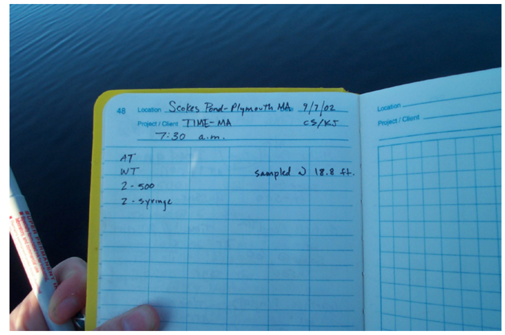
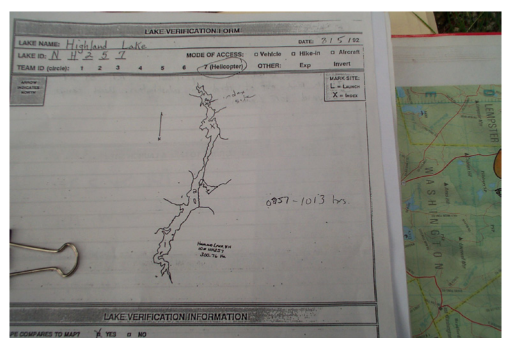
Acknowledgements

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 Long hikes with outdated directions and no GPS reception; trails not maintained in decades, ankle-busters, no trespassing signs, poison ivy, and angry locals; hot weather,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

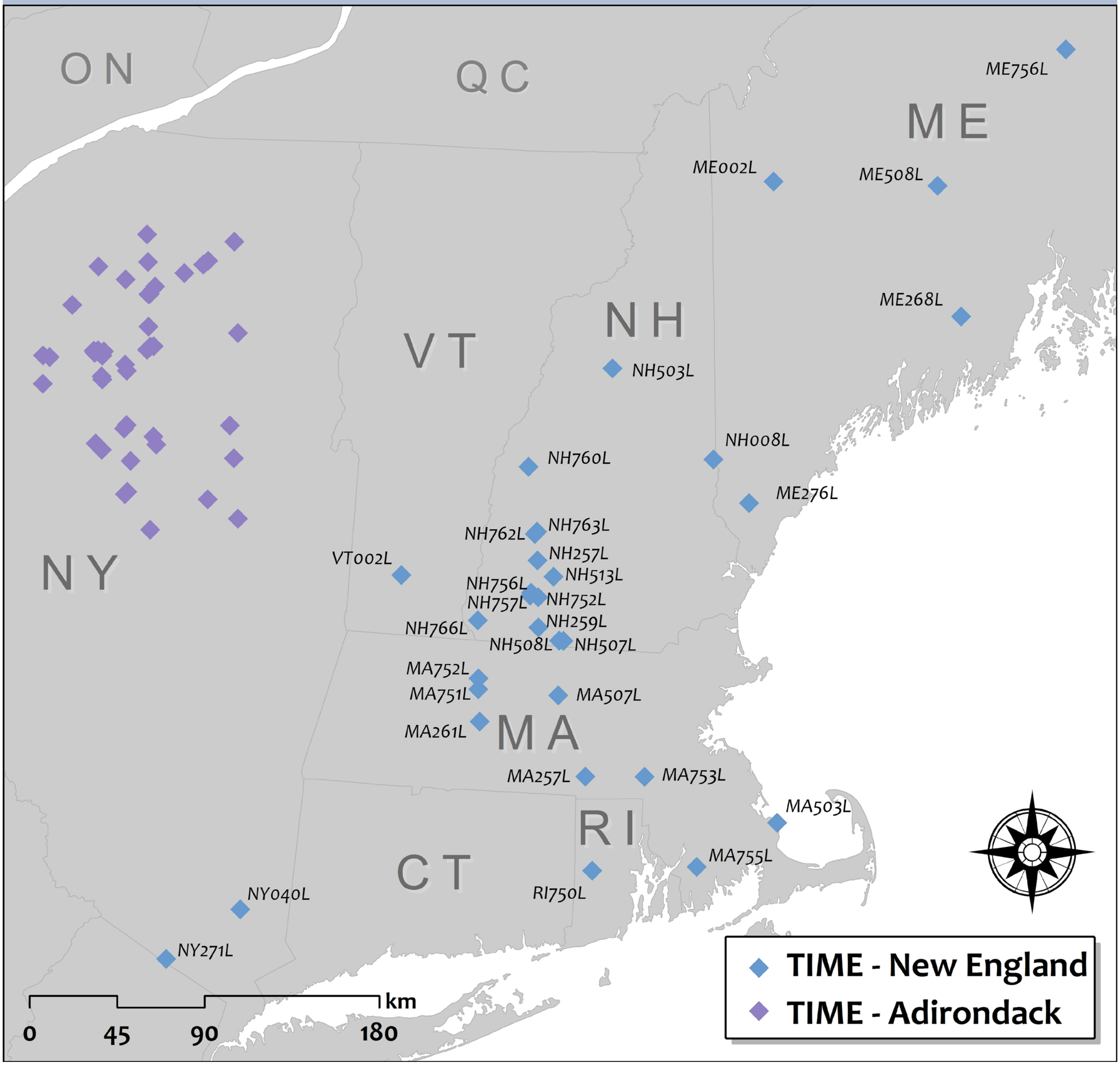


Figure 1. The 31 TIME New England lakes - which also include two lakes in the lower Hudson River Valley of New York state - are the subjects of this report. The 43 TIME Adirondack lakes are part of the same long-term monitoring program, and are summarized in a compendium of lakes spanning multiple research 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.

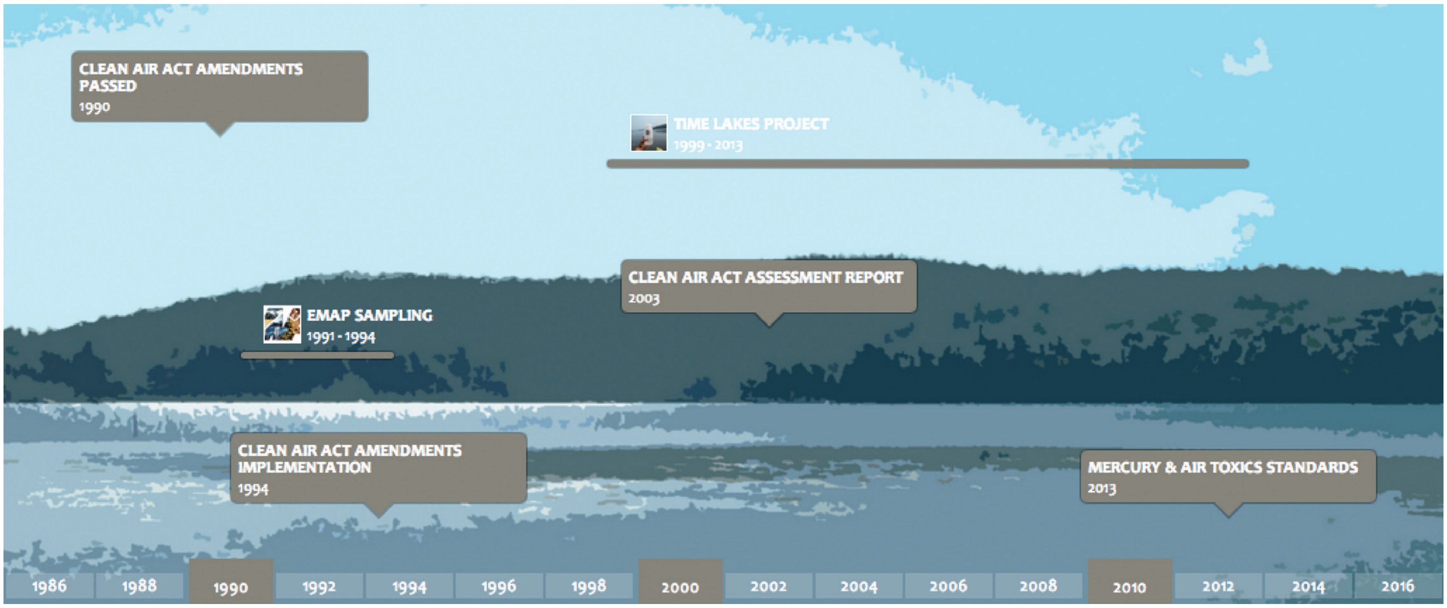
Variable	Units	Detection limit	Method
EqpH	pH units	n/a	Air-equilibrated pH, determined by electrode
ClpH	pH units	n/a	Closed-cell pH, determined by electrode
ANC	$\mu eq \cdot L^{-1}$	n/a	Acid-neutralizing capacity, determined by Gran titration
DOC	$mg \cdot L^{-1}$	0.1	Dissolved organic carbon, determined by infrared carbon analyzer, persulfate oxidation
Cond	$\mu S \cdot cm^{-1}$	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+}	$\mu eq \cdot L^{-1}$	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+}	$\mu eq \cdot L^{-1}$	0.8	
K^+	$\mu eq \cdot L^{-1}$	0.3	
Na^+	$\mu eq \cdot L^{-1}$	0.4	
Al (Total)	$\mu g \cdot L^{-1}$	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-}	$\mu eq \cdot L^{-1}$	0.5	Ion Chromatography
NO_3^-	$\mu eq \cdot L^{-1}$	0.1	Ion Chromatography
Cl^-	$\mu eq \cdot L^{-1}$	0.5	Ion Chromatography
SiO_2	$mg \cdot L^{-1}$	0.1	Silica (as SiO_2), determined by autoanalyzer; 2006 and later.
Total P	$\mu g \cdot L^{-1}$	0.5	Total phosphorus, determined by manual colorimetry
Total N	$\mu g \cdot L^{-1}$	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/

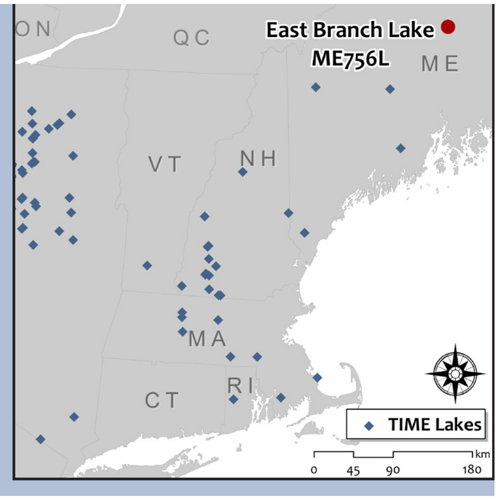
University of Maine sampling in 2003.

Photo: C. Rosfjord.

East Branch Lake

Lake ID: ME756L

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

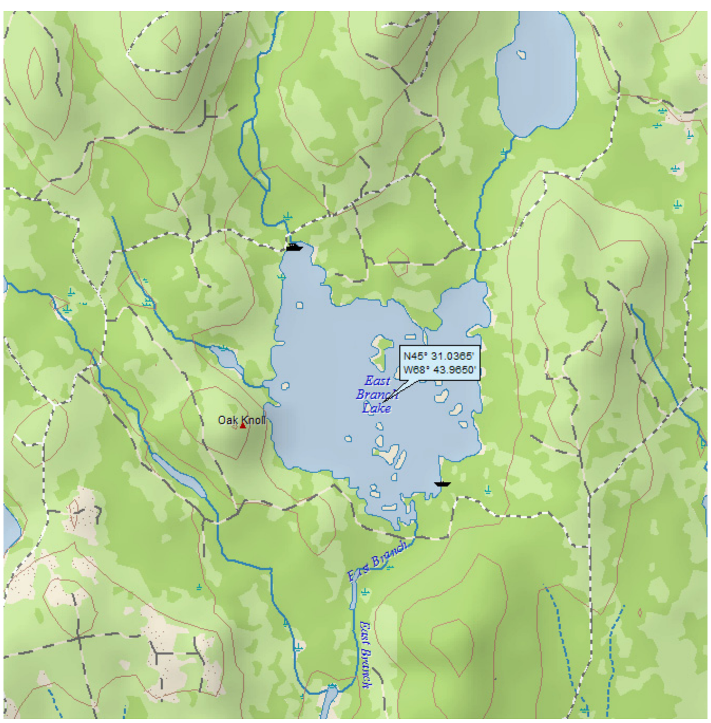


Lake description

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 (map, Appendix A), 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]

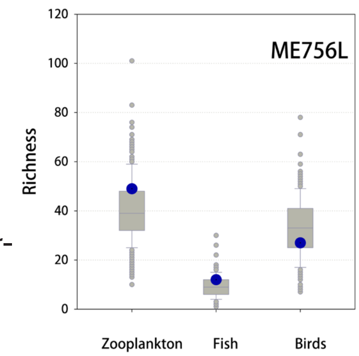
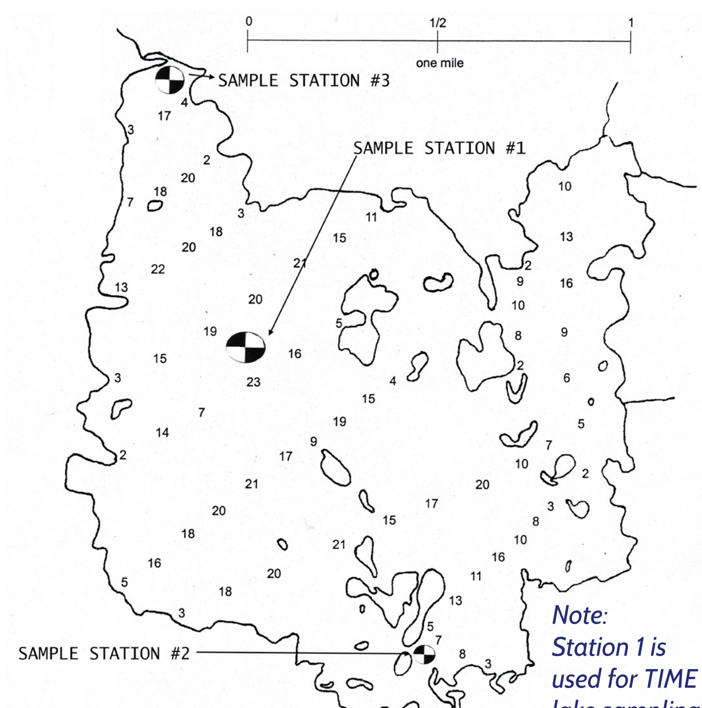


Figure ME756L.1. Zooplankton, bird, and fish species richness for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dots).



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%)	

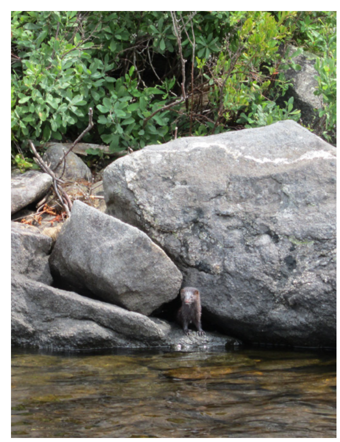
Table ME756L.2. Long-term chemistry for East Branch, 1994-2010. See Introduction for explanation of variables and methodology. Samples were taken during the summer index period.

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.

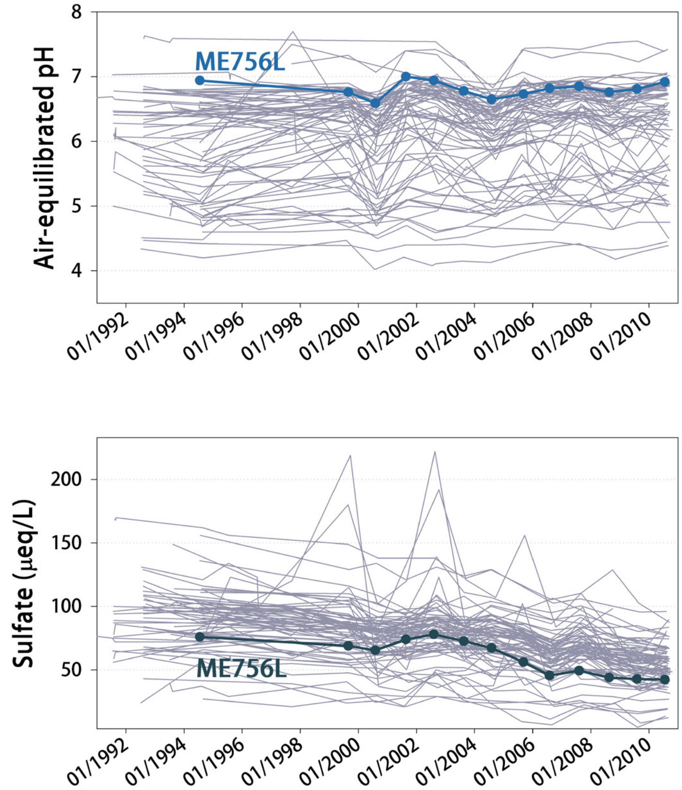


Figure ME756L.2. 1992-2010 time series data for air-equilibrated pH (top panel) and sulfate (bottom panel) concentrations in all 74 TIME lakes (including Adirondack lakes). East Branch Lake (thick blue line) has had among the highest pH and lowest sulfate measurements in the TIME dataset. Sulfate has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

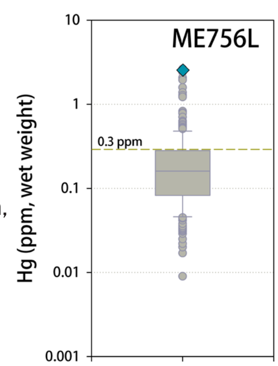


Figure ME756L.4. Fish mercury (Hg) concentration in fillets for all EMAP lakes sampled during 1991-1995[3] (gray box plot) and for this lake (blue dot). East Branch Lake was sampled in 1994. Its smallmouth bass (*Micropterus dolomieu*) sample was 2.63 ppm, wet weight, the highest in the EMAP dataset.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

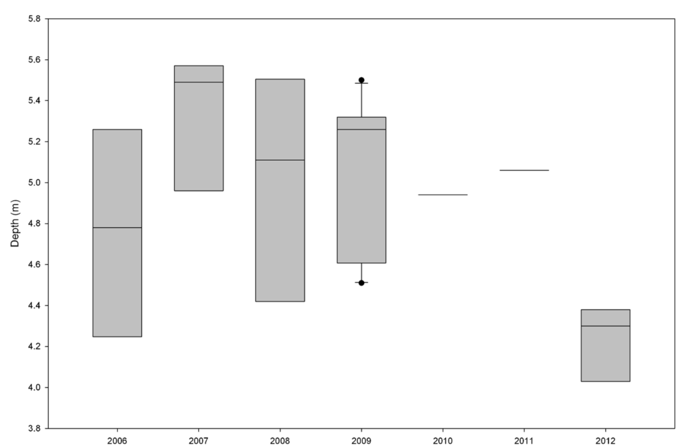


Figure ME756L.3. East Branch Lake Secchi disk transparency (in meters) since 2006. Tranparency typically ranged between 4-5.5 meters. Figure courtesy of D. Kuznierz, PINWRP.

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.

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.

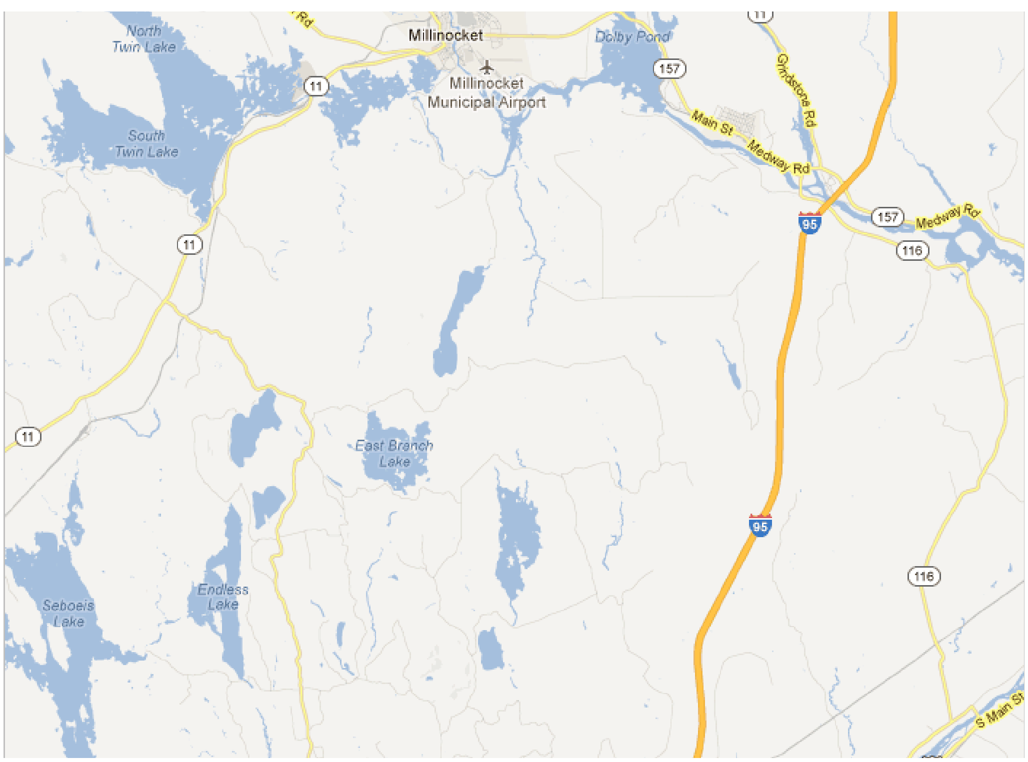
View from launch toward sampling station

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