LCI Lake Water Quality Summary

Lake Name: Hadlock Pond

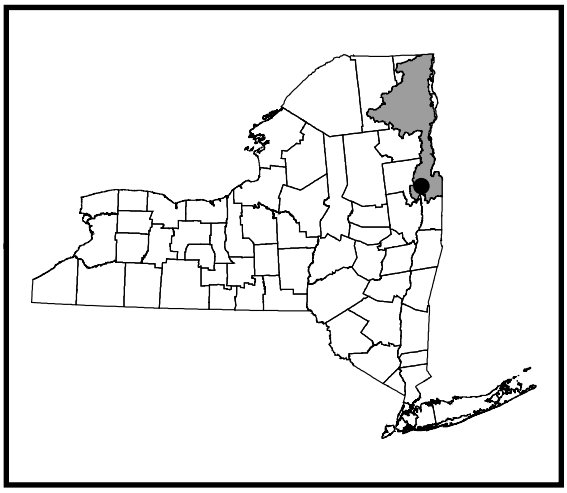
Location: Town of Fort Ann, Washington County, NY
Basin: Lake Champlain Basin
Size: 111.4 hectares (195 acres)
Lake Origins: glacial lake with some modifications
Major Tributaries: Bishop Brook
Lake Tributary to?: Halfway Creek
Water Quality Classification: AA(T) (best intended use: potable water)
(T) denotes that the waters be suitable for trout survival

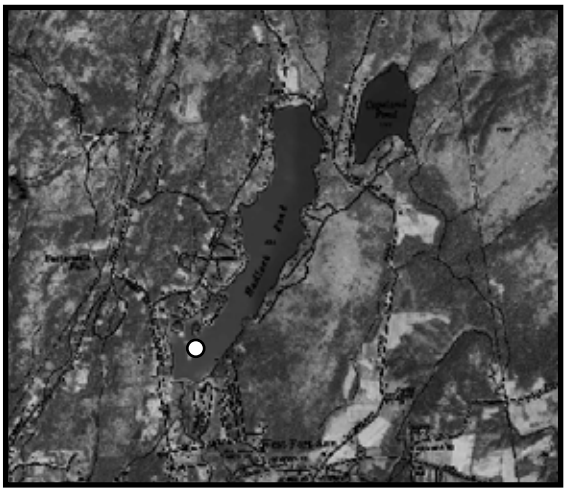
Sounding Depth: 6.5 meters
Sampling Coordinates: Latitude: 43.4165, Longitude: -73.5571
Sampling Access Point: Private Property near dam

Monitoring Program: Lake Classification and Inventory (LCI) Survey
Sampling Date: July 15 and September 11, 2009
Samplers: Vince Spadaro, NYSDEC Division of Water, Warrensburg

Contact Information: Scott Kishbaugh, NYSDEC Division of Water
sakishba@gw.dec.state.ny.us; 518-402-8282

Lake Map:
(sampling location marked with a circle)





Background and Lake Assessment

Hadlock Pond is a 208 acre impoundment in the town of Fort Ann, Washington County, NY. The town of Fort Ann owns the lake; however, there is no public access to the pond. There are many houses along the near shore area of the pond with the majority of the watershed being forested. The water level in Hadlock Pond is controlled by the dam at the southern end of the pond. The pond historically supported swimming, boating (motorized and non-motorized), and fishing.

Hadlock Pond was included in the 2009 intensive Lake Classification and Inventory (LCI) survey due to a "needs verification" listing in the 2009 Lake Champlain Basin Waterbody Inventory and Priority Waterbodies List (WI-PWL). The listing in the WI-PWL was due to potential water quality and lake uses impairments that resulted from hydrologic changes and habitat alteration that occurred due to partial dam failure in July of 2005. The dam was rebuilt in early 2007. Data from 1997 to 2001 indicated no evidence of impacts to water quality or recreational uses.

From the data collected in 2009, Hadlock Pond can be characterized as *mesoligotrophic* moderately unproductive. The water clarity readings (TSI = 40, typical of *oligotrophic* to *mesoligotrophic* lakes), was in the expected range given the chlorophyll *a* readings (TSI = 39, at the high end of *oligotrophic* lakes) and the phosphorus readings (TSI = 35, typical of *oligotrophic* lakes) in the lake. These data indicate that baseline nutrient levels do not support persistent algal blooms. However, it is noted that the Lake Hadlock Association (2010) reports that algal blooms do occur in the pond during the summer.

The *mesoligotrophic* conditions are consistent with the data collected from 1997 to 2001. The LCI water clarity readings were both below the range of values observed between 1997 and 2001 and were consistent with water clarity readings taken in 2008 and 2009 by the Lake Hadlock Association (2010). The LCI total phosphorus and chlorophyll *a* levels were within the range of values observed between 1997 and 2001.

Darrin Freshwater Institute conducted a detailed plant survey in September of 2009, which found four invasive species were present in the lake as well as 22 native species (Eichler and Boylen 2009). Drawdown and harvesting (mechanical and hand) are currently used on the pond to help control excessive vegetation growth and improve recreation opportunities (Lake Hadlock Association 2010).

Hadlock Pond exhibits thermal stratification, in which depth zones (warm water on top, cold water on the bottom during the summer) are established, as in most NYS lakes greater than six meters in depth. The thermocline was found at a depth of about five to six meters during the July and September sampling events. Below the thermocline, temperature and dissolved oxygen levels dropped off. At the sampling site, corresponding to the deepest portion of the lake (6.5 meters deep), the bottom one to two meters of the water column was hypoxic (oxygen poor). It is not known if hypoxic or anoxic (lack of oxygen) conditions are consistently present in the deeper areas of the pond during the summer. pH readings were basic/alkaline and decreased with lake depth. Conductivity readings indicate soft water (low ionic strength), which is common for water bodies within the Adirondacks.

The lake appears to be a typical softwater, uncolored, alkaline lake. Other lakes with similar water quality characteristics may support warmwater fisheries. However, fisheries habitat cannot be fully evaluated though this monitoring program. Coldwater fisheries may be stressed due to the hypoxic conditions found below five meters. It is not known if these coldwater fish have historically been supported in the pond.

Total phosphorus levels were low in both the surface and bottom waters. Dissolved phosphorus in the surface water was low, indicating that most of the available phosphorus is already tied up in primary production (i.e. within algae cells). Like most New York State lakes, Hadlock Pond is phosphorus limited, which indicates that any phosphorus additions to the lake will fuel primary production in the form of algae. Chloride and other ions were low, which is typical of lakes in forested watersheds. Iron and manganese levels were elevated in the bottom waters with both iron samples and one of the two manganese samples being above New York State Department of Health's guidance values. Elevated iron and manganese levels are often found in water bodies that have persistent oxygen deficits, and may impact any potable water use of the lake.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Hadlock Pond is classified for use as a potable water supply. The LCI data are not sufficient to evaluate potable water use; however, these data indicate that deepwater withdrawals maybe impacted by elevated iron and manganese levels.

Contact Recreation (Swimming)

Bacteria data are needed to evaluate the safety of the lake for swimming; however these data are not collected through the LCI. These data are collected by the Lake Hadlock Association. A summary report of their findings indicates that during 2008 and 2009 bacteria levels were consistently above the state standards for contact recreation. This summary report also had data from a 2009 survey of 70 lake shore residents; the results from this survey indicated that many residents found that aquatic weeds were making swimming in the pond difficult (Lake Hadlock Association 2010).

Non-Contact Recreation (Boating and Fishing)

The survey of lake shore resident conducted by the Lake Hadlock Association (2010) indicated that some residents found aquatic weeds were impacting boating (clogged or stalled motors) and fishing (inability to fish from the shoreline) on the lake.

Aquatic Life

The low levels of dissolved oxygen in the bottom waters may stress some aquatic life; however, no direct affects of this were observed. Additional biological studies would need to be conducted to fully evaluate aquatic life.

Aesthetics

The survey of lake shore resident conducted by the Lake Hadlock Association (2010) indicated that some residents feel that aquatic weeds were detracting from the pond's aesthetics as well decreasing property values.

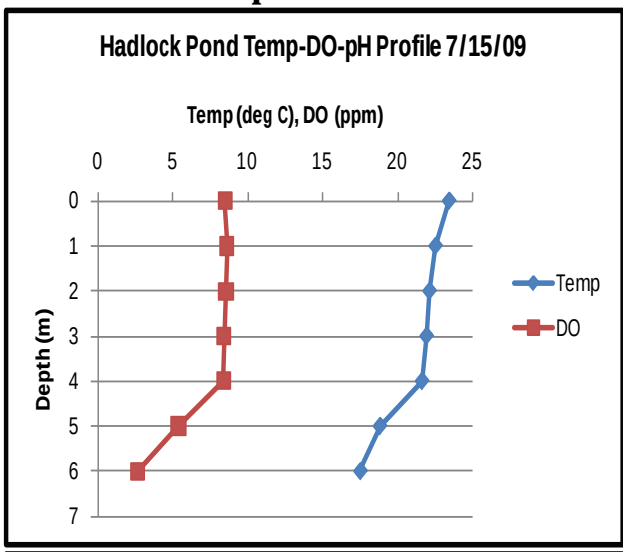
Additional Comments

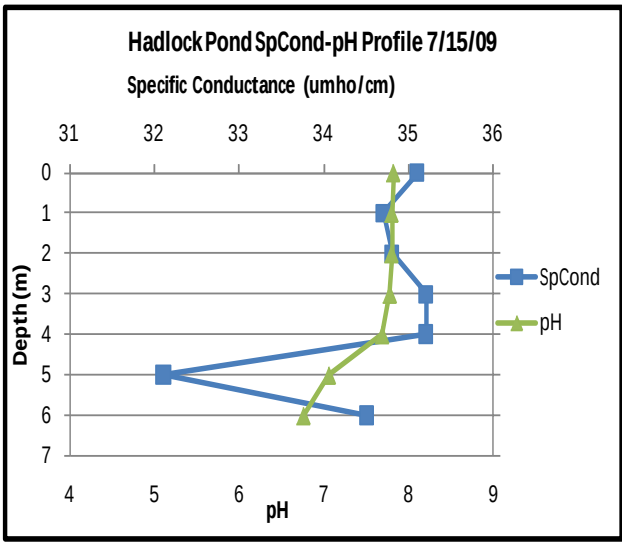
- Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of any new invaders, given the escalating problems with exotic aquatic weeds. Educating the people who use the pond to the risk of invasive species and methods they can use to prevent their spread to Hadlock Pond would help minimize the threat of any other invasive species from inadvertently being introduced.
- Continuing the hand harvesting of water chestnut will reduce the risk of the plant becoming fully established in the pond.
- Reduction of nutrient inputs to the pond by ensuring septic systems are properly sighted and maintained and liming the use of fertilizers in the watershed may help reduce the occurrence of algal blooms in the pond.

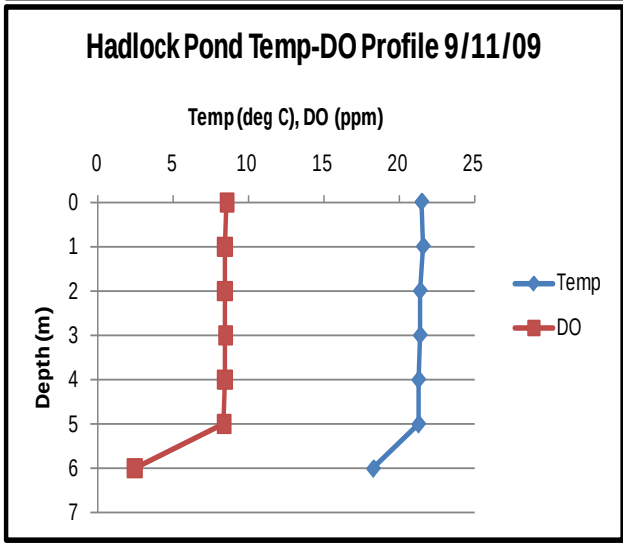
Aquatic Plant IDs

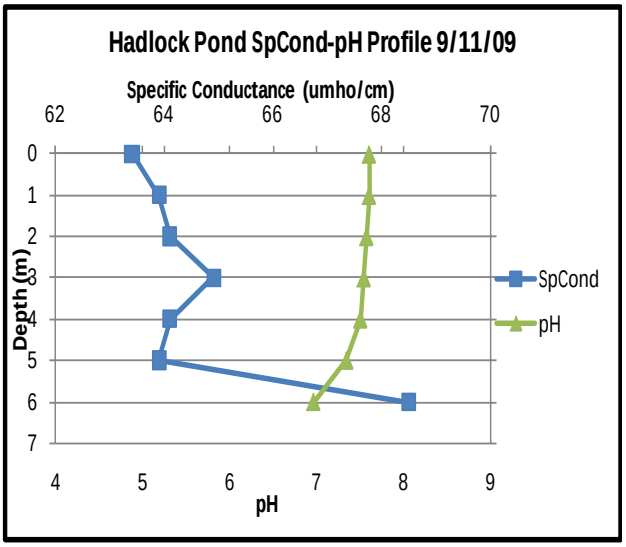
The aquatic plants observed in the pond were not recorded by DEC staff; however, Darrin Fresh Water Institute conducted a detailed plant survey of the pond in September of 2009. The results from this survey indicated four invasive species: *Myriophyllum spicatum*, *Najas minor*, *Potamogeton crispus* and *Trapa natans*. In addition, 22 native aquatic plants species were also found during the 2009 survey (Eichler and Boylen 2009).

Time Series: Depth Profiles

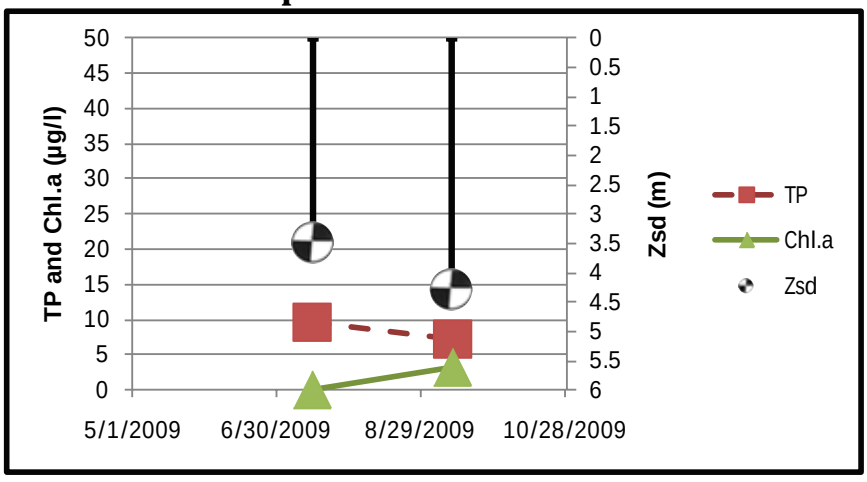








Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	2	3.5	3.9	4.3	Mesotrophic	No readings violate DOH guidance value
TSI-Secchi			41.9	40.4	39.0	Mesotrophic	No pertinent water quality standards
TP	mg/l	2	0.0073	0.0085	0.0096	Oligotrophic	No readings violate DOH guidance value
TSI-TP			32.8	35.0	36.7	Oligotrophic	No pertinent water quality standards
TSP	mg/l	2	0.0031	0.0037	0.0042	Little available phosphorus	No pertinent water quality standards
NOx	mg/l	2	0.0041	0.0445	0.0093	Low nitrate	No readings violate DOH guidance value
NH4	mg/l	2	ND	0.045	0.084	Low ammonia	No readings violate DOH guidance value
TKN	mg/l	2	0.23	0.27	0.31	Low organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	2	53.65	74.94	96.23	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	2	ND	2.1*	3.2	Mesotrophic	No pertinent water quality standards
TSI-CHLA			ND	37.89*	42.0	Oligotrophic	No pertinent water quality standards
Alkalinity	mg/l	2	33.5	34.1	34.7	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	2	5	7.5	10	Uncolored	No pertinent water quality standards
TOC	mg/l	2	4.1	4.2	4.3		No pertinent water quality standards
Ca	mg/l	2	10.4	10.7	11	Minimally Supports Zebra Mussels	No pertinent water quality standards
Fe	mg/l	2	0.138	0.151	0.164		No readings violate DOH guidance value
Mn	mg/l	2	0.0187	0.021	0.0232		No readings violate DOH guidance value
Mg	mg/l	2	2.49	2.53	2.57		No readings violate DOH guidance value
K	mg/l	2	0.317	0.34	0.36		No pertinent water quality standards
Na	mg/l	2	2.06	2.08	2.1		No readings violate DOH guidance value
Cl	mg/l	2	2.8	3	3.2	Minor road salt runoff	No readings violate DOH guidance value
SO4	mg/l	2	5	5.05	5.1		No readings violate DOH guidance value

* The average chlorophyll *a* was determined using half the detection limit for non-detect samples.

Bottom Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
TP-bottom	mg/l	2	0.0057	0.0081	0.0105		No pertinent water quality standards
TSP-bottom	mg/l	2	0.0071	0.0122	0.0172	High % soluble phosphorus	No pertinent water quality standards
NOx-bottom	mg/l	2	0.0036	0.0055	0.0073	No evidence of DO depletion	No readings violate DOH guidance value
NH4-bottom	mg/l	2	0.022	0.062	0.101	No evidence of DO depletion	No readings violate DOH guidance value
TKN-bottom	mg/l	2	0.3	0.36	0.42		No pertinent water quality standards
Alk-bottom	mg/l	2	33.3	35.2	37	Poorly Buffered	No pertinent water quality standards
TCOLOR-bottom	ptu	2	20	25	30	Weakly Colored	No pertinent water quality standards
TOC-bottom	mg/l	2	3.5	3.8	4		No pertinent water quality standards
Ca-bottom	mg/l	2	10.2	10.7	11.2		Strongly Supports Zebra Mussels
Fe-bottom	mg/l	2	0.433	0.8815	1.33	Taste or odor likely	100% of readings violate DOH guidelines
Mn-bottom	mg/l	2	0.147	0.7635	1.38	Taste or odor likely	50% of readings violate DOH guidelines
Mg-bottom	mg/l	2	2.39	2.4	2.46		No readings violate DOH guidance value
K-bottom	mg/l	2	0.373	0.48	0.589		No pertinent water quality standards
Na-bottom	mg/l	2	1.89	1.9	1.94		No readings violate DOH guidance value
Cl-bottom	mg/l	2	2.7	2.9	3.1		No readings violate DOH guidance value
SO4-bottom	mg/l	2	4.2	4.5	4.8		No readings violate DOH guidance value

Legend Information

General Legend Information

Surface Samples = integrated sample collected in the first 2 meters of surface water
Bottom Samples = grab sample collected from a depth of approximately 1 meter from the lake bottom
N = number of samples
SECCHI = Secchi disk water transparency or clarity - measured in meters (m)
TSI-SECCHI = Trophic State Index calculated from Secchi, = 60 – 14.41*ln(Secchi)

Laboratory Parameters

ND = Non-Detect, the level of the analyte in question is at or below the laboratory's detection limit
TP = total phosphorus- milligrams per liter (mg/l)
Detection limit = 0.003 mg/l; NYS Guidance Value = 0.020 mg/l
TSI-TP = Trophic State Index calculated from TP, = 14.42*ln(TP*1000) + 4.15
TSP = total soluble phosphorus, mg/l
Detection limit = 0.003 mg/l; no NYS standard or guidance value
NOx = nitrate + nitrite nitrogen, mg/l
Detection limit = 0.01 mg/l; NYS WQ standard = 10 mg/l
NH4 = total ammonia, mg/l
Detection limit = 0.01 mg/l; NYS WQ standard = 2 mg/l
TKN = total Kjeldahl nitrogen (= organic nitrogen + ammonia), mg/l
Detection limit = 0.01 mg/l; no NYS standard or guidance value
TN/TP = Nitrogen to Phosphorus ratio (molar ratio), = (TKN + NOx)*2.2/TP
> 30 suggests phosphorus limitation, < 10 suggests nitrogen limitation
CHLA = chlorophyll *a*, micrograms per liter (µg/l) or parts per billion (ppb)
Detection limit = 2 µg/l; no NYS standard or guidance value
TSI-CHLA = Trophic State Index calculated from CHLA, = 9.81*ln(CHLA) + 30.6
ALKALINITY = total alkalinity in mg/l as calcium carbonate
Detection limit = 10 mg/l; no NYS standard or guidance value
TCOLOR = true (filtered or centrifuged) color, platinum color units (ptu)
Detection limit = 5 ptu; no NYS standard or guidance value
TOC = total organic carbon, mg/l
Detection limit = 1 mg/l; no NYS standard or guidance value
Ca = calcium, mg/l
Detection limit = 1 mg/l; no NYS standard or guidance value
Fe = iron, mg/l
Detection limit = 0.1 mg/l; NYS standard = 0.3 mg/l
Mn = manganese, mg/l
Detection limit = 0.01 mg/l; NYS standard = 0.3 mg/l
Mg = magnesium, mg/l
Detection limit = 2 mg/l; NYS standard = 35 mg/l
K = potassium, mg/l
Detection limit = 2 mg/l; no NYS standard or guidance value
Na = sodium, mg/l
Detection limit = 2 mg/l; NYS standard = 20 mg/l
Cl = chloride, mg/l
Detection limit = 2 mg/l; NYS standard = 250 mg/l
SO4 = sulfate, mg/l
Detection limit = 2 mg/l; NYS standard = 250 mg/l

Field Parameters

Depth = water depth, meters
Temp = water temperature, degrees Celsius
D.O. = dissolved oxygen, in milligrams per liter (mg/l) or parts per million (ppm)

NYS standard = 4 mg/l; 5 mg/l for salmonids

pH = powers of hydrogen, standard pH units (S.U.)
Detection limit = 1 S.U.; NYS standard = 6.5 and 8.5

SpCond = specific conductance, corrected to 25ºC, micromho per centimeter (µmho/cm)
Detection limit = 1 µmho/cm; no NYS standard or guidance value

ORP = Oxygen Reduction Potential, millivolts (MV)
Detection limit = -250 mV; no NYS standard or guidance value

References

Eichler, L. and C. Boylen. 2009. Hadlock Pond Aquatic Plant Survey – 2009. Accessed at http://www.lakehadlock.org/PDF Files/Darren Freshwater Final Report 2009 Hadlock Pond.pdf

Lake Hadlock Association. 2010. Hadlock Pond Aquatic Plant Management Plan. Accessed at http://www.lakehadlock.org/MS Word Documents/ Aquatic Invasive Species Plant Treatment Alternatives (Appendix 10).doc