Volunteer Lake Assessment Program Individual Lake Reports

WINONA, LAKE, NEW HAMPTON, NH

MORPHOMETRIC DATA

Watershed Area (Ac.):	3,328	**Max. Depth (m):**	14.6	**Flushing Rate (yr^{1})**	2.1
Surface Area (Ac.):	154	**Mean Depth (m):**	5.2	**P Retention Coef:**	0.54
Shore Length (m):	5,000	**Volume (m^{3}):**	3,161,000	**Elevation (ft):**	540

TROPHIC CLASSIFICATION

Year	Trophic class
1987	MESOTROPHIC
2005	MESOTROPHIC

KNOWN EXOTIC SPECIES

The Waterbody Report Card tables are generated from the DRAFT 2014 305(b) report on the status of N.H. waters, and are based on data collected from 2004-2013. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organizations/divisions/water/wmb/swqa/index.htm

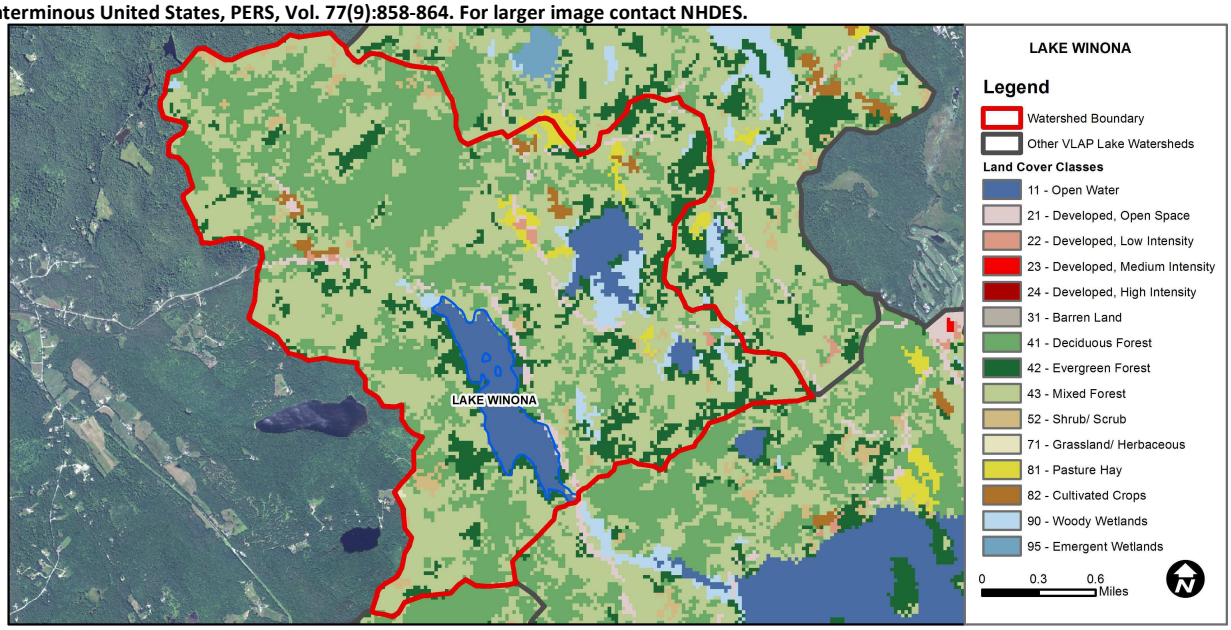
Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Good	The calculated median is from 5 or more samples and is < indicator and > 1/2 indicator and the chlorophyll a indicator is okay.
	pH	Slightly Bad	>10% of samples exceed criteria by a small margin (minimum of 2 exceedances).
	Oxygen, Dissolved	Bad	There are >10% of samples (minimum of 2), exceeding criteria with one or more samples considered large exceedance.
	Dissolved oxygen satura	Slightly Bad	There are >10% of samples (minimum of 2), exceeding criteria.
	Chlorophyll-a	Good	The calculated median is from 5 or more samples and is < indicator and > 1/2 indicator.
Primary Contact Recreation	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.
	Chlorophyll-a	Very Good	There are a total of at least 10 samples with 0 exceedances of indicator.

BEACH PRIMARY CONTACT ASSESSMENT STATUS

LAKE WAUKEWAN - TOWN BEACH	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.

WATERSHED LAND USE SUMMARY

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PERS, Vol. 77(9):858-864. For larger image contact NHDES.



Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	7.09	Barren Land	0	Grassland/Herbaceous	0.04
Developed-Open Space	1.83	Deciduous Forest	30.07	Pasture Hay	1.16
Developed-Low Intensity	0.27	Evergreen Forest	10.89	Cultivated Crops	0.79
Developed-Medium Intensity	0	Mixed Forest	43.84	Woody Wetlands	2.3
Developed-High Intensity	0	Shrub-Scrub	1.58	Emergent Wetlands	0

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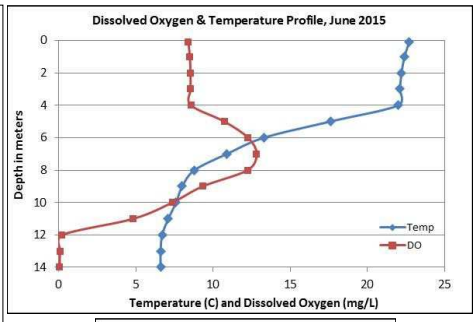
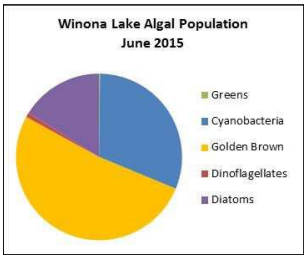
2015 Data Summary

Recommended Actions: Chlorophyll levels have indicated potential algal bloom conditions in recent years. Hypolimnetic phosphorus has also spiked in mid to late summer indicating that internal phosphorus loading is likely occurring. This internal load is likely fueling the elevated algal growth. This highlights the importance of minimizing external phosphorus loads to the lake from the surrounding watershed through the use of phosphate free fertilizers and properly maintaining septic systems. The increased frequency and intensity of storm events and fluctuating water levels in recent years could also contribute to the phosphorus load and managing stormwater runoff is important. DES' "NH Homeowner's Guide to Stormwater Management" is a great resource for property owners to implement stormwater best practices on their properties.

Observations (*Refer to Table 1 and Historical Deep Spot Data Graphics)*

- **Chlorophyll-a:** Chlorophyll levels were low in June and increased to elevated levels in July and were approaching levels indicative of an algal bloom. Average chlorophyll levels decreased slightly from 2014 yet were greater than the state median and have increased steadily since 2010. Historical trend analysis indicates relatively stable chlorophyll levels since monitoring began.
- **Conductivity/Chloride:** Deep spot, Heights Bk., North Inlet, and Outlet conductivity and chloride levels remained slightly greater than the state medians. Average epilimnetic (upper water layer) conductivity increased sharply in 2015 and historical trend analysis indicates significantly increasing (worsening) epilimnetic conductivity since monitoring began. Hawkins Pond Inlet and Jean Chutes conductivity and chloride levels were slightly greater than the other stations and indicative of the impacts of winter road salting. North Cove West and York Brook conductivity levels were low to average.
- **E. coli:** E. coli levels at all stations were low and much less than the state standards for public beaches (88 cts/100 mL) and surface waters (406 cts/100 mL).
- **Total Phosphorus:** Epilimnetic and metalimnetic (middle water layer) phosphorus levels were low in June and July, however hypolimnetic (lower water layer) phosphorus was low in June and greatly elevated in July. The turbidity of the sample was also elevated and laboratory notes indicate highly colored water. This indicates that phosphorus is likely released from bottom sediments when dissolved oxygen levels decrease below 1.0 mg/L, a process called internal phosphorus loading. This internal phosphorus source can be utilized by algae and cause elevated algal growth as seen in July. Hawkins Pond Inlet, Jean Chutes, North Cove West, North Inlet, Outlet, and York Brook phosphorus levels were within low to average ranges. Heights Brook Inlet phosphorus levels were low in June and increased to slightly elevated levels in July and sediment was noted in the sample.
- **Transparency:** Transparency remained stable from June to July and was better than the state median, however historical trend analysis indicates significantly decreasing (worsening) transparency since monitoring began. The elevated July algal growth did not seem to affect the transparency potentially due to a layer of algae located deeper than 5.0 or 6.0 meters.
- **Turbidity:** Epilimnetic turbidity was stable and low from June to July. Metalimnetic turbidity was slightly above average for that station in June and July potentially due to algal growth. Hypolimnetic turbidity was low in June and greatly elevated in July due to the formation and accumulation of organic compounds under anoxic conditions. Hawkins Pond Inlet, Jean Chutes, North Cove West, and Outlet turbidities were low. Heights Bk. and North Inlet turbidity was low in June and slightly elevated in July due to low flow conditions.
- **pH:** Epilimnetic pH was within the desirable range 6.5-8.0 units and historical trend analysis indicates relatively stable pH with moderate variability between years. Metalimnetic pH was good in June and decreased below desirable levels in July and hypolimnetic pH remains less than desirable. Tributary pH levels were generally within the desirable range.





NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.
Chloride: > 230 mg/L (chronic)
E. coli: > 88 cts/100 mL – public beach
E. coli: > 406 cts/100 mL – surface waters
Turbidity: > 10 NTU above natural level
pH: between 6.5-8.0 (unless naturally occurring)

NH Median Values: Median values for specific parameters generated from historic lake monitoring data.
Alkalinity: 4.9 mg/L
Chlorophyll-a: 4.58 mg/m^3
Conductivity: 40.0 uS/cm
Chloride: 4 mg/L
Total Phosphorus: 12 ug/L
Transparency: 3.2 m
pH: 6.6

Table 1. 2015 Average Water Quality Data for WINONA LAKE

Station Name	Alk. mg/l	Chlor-a ug/l	Chloride mg/l	Cond. uS/cm	E. Coli #/100ml	Total P ug/l	Trans. m		Turb. ntu	pH
							NVS	VS		
Epilimnion	7.3	7.24	14	79.6		6	5.00	6.00	0.70	6.78
Metalimnion				68.5		10			1.13	6.62
Hypolimnion				77.6		35			11.21	6.11
Hawkins Pond Inlet			26	115.7	15	14			1.11	6.69
Heights Brook Inlet			8	64.0	30	12			1.89	6.32
Jean Chutes			21	131.3	40	10			0.80	6.65
North Cove West				17.5		3			0.20	6.44
North Inlet			14	72.4	10	8			1.39	6.75
Outlet			15	74.7	10	8			0.69	6.56
York Brook				45.6	20	5			0.26	6.76

Historical Water Quality Trend Analysis

Parameter	Trend	Explanation	Parameter	Trend	Explanation
Conductivity	Worsening	Data significantly increasing.	Chlorophyll-a	Stable	Trend not significant; data show low variability.
pH (epilimnion)	Stable	Trend not significantly; data moderately variable.	Transparency	Worsening	Data significantly decreasing.
			Phosphorus (epilimnion)	Stable	Trend not significant; data highly variable.