# LCI Lake Water Quality Summary

## General Information

## Lake Name: Bodine Lake

**Location:** Yulan, Town of Highland, Sullivan County
**Basin:** Delaware River Basin
**Size:** 7.8 hectares (= 19 acres)
**Lake Origins:** natural
**Major Tributaries:** minor unnamed tributary from Montgomery Lake
**Lake Tributary to?:** Beaver Brook via a minor unnamed tributary
**Water Quality Classification:** B (best intended use: primary contact recreation)

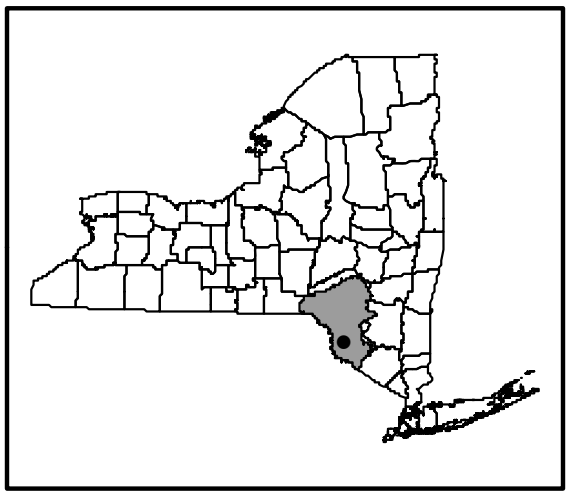
**Sounding Depth:** 4.5 meters (= 15 feet)
**Sampling Coordinates:** Latitude: 41.52164, Longitude: -74.92780
**Sampling Access Point:** private land (Oskana Charla)

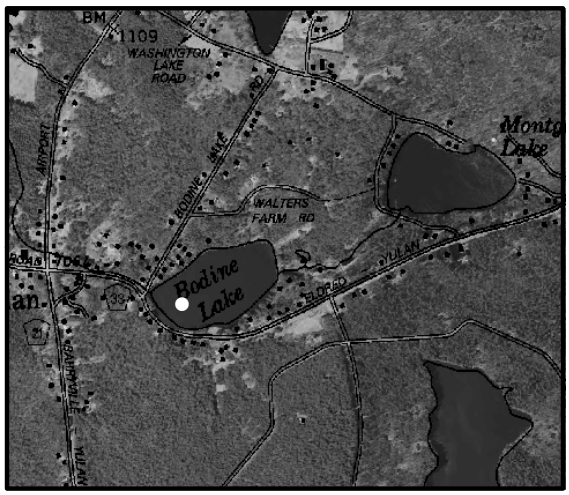
**Monitoring Program:** Lake Classification and Inventory (LCI) Survey
**Sampling Date:** July 29, 2009
**Samplers:** David Newman, NYSDEC Division of Water, Albany
Steven Finnemore, NYSDEC Division of Water, Albany

**Contact Information:** David Newman, NYSDEC Division of Water
djnewman@gw.dec.state.ny.us; 518-402-8201

## Lake Map

(sampling location marked with a circle)





## Background and Lake Assessment

Bodine Lake is a small body of water in southwestern Sullivan County. The lake has several seasonal use houses/camps as well as permanent residences surrounding the lake. The lake shore is mostly forested although Eldred-Yulan Road boarders the lake on the western shore. The lake appears to support non-motorized boating and fishing, and lake shore residents do swim in the lake when conditions allow.

Bodine Lake was sampled through the NYSDEC Division of Water's screening Lake Classification and Inventory Survey program in July of 2009. Inclusion in the program was based on algal blooms observed during the summer of 2008, samples from this bloom were found to contain algae that are capable of producing toxins that can be harmful to human health. The lake is a candidate for more intensive sampling during the summer of 2010 based on perceived water quality problems related to algal blooms.

Bodine Lake can be characterized as *mesoeutrophic*, or moderately to highly productive. The water clarity reading (TSI = 47, typical of *mesoeutrophic* lakes) was similar to those expected given the phosphorus reading (TSI = 45, typical of *mesotrophic* lakes) and chlorophyll *a* reading (TSI = 46, typical of *mesotrophic* lakes) in the lake. These data indicate that an algal bloom was not occurring at the time the sample was taken; however, observations taken by a lake shore resident, a few weeks after this sampling session, suggest that a bloom did occur during the summer of 2009.

Like most New York State lakes, phosphorus was determined to be the limiting nutrient in Bodine Lake. This means that phosphorus additions to the lake fuel primary production in the form of algae. Sources of phosphorus to the lake may include septic systems, stormwater runoff, soil erosion, and fertilizers used on lawns in the lake's watershed.

During the late July sampling effort, patches of algae were observed near the lake shoreline. A water sample was taken of one of these patches and submitted to the NYS Department of Health (DOH) for an algal toxin analysis. This sample was run through a phyococyanin detector and recorded readings of 17 fluorescence units. Any sampling results below 100 units are thought to indicate less than 1.0 µg/l of microcystis-LR, corresponding to the World Health Organization (WHO) guidance to protect drinking water supplies. The results from these detectors can be highly variable, and should only be used as an indication of a potential problem. Some species of cyanobacteria can produce toxins, such as microcystis-LR, and others can be implicated in taste and odor problems. So while the presence of cyanobacteria does not necessarily indicate water quality problems or the presence of harmful algal blooms, it may warrant additional investigation.

Samples taken by a lake shore resident in late August were also submitted to NYSDOH for algal toxin analysis. As of this writing these results have not been provided to the NYSDEC. If and when these results are given to the NYSDEC an addendum to this report will be written and sent out.

The lake appeared to be slightly brown, as was typical for most of the lakes sampled in the area. This light brown or tan color is caused by tannic and or humic acids entering the lake from the

watershed. Due to inclement weather at the time of the sampling, an assessment of the plant community at the lake was not completed. However, no exotic plants were observed.

Bodine Lake may exhibit weak thermal stratification, in which depth zones (warm water on top, cold water on the bottom during the summer) are established. Temperature and dissolved oxygen readings were comparable for the top three meters of the lake and then showed a marked decline at about four meters. The hypolimnion (bottom waters) was hypoxic (poorly oxygenated) at four meters. pH readings indicate slightly alkaline water and conductivity readings indicate intermediate water hardness. The former is typical of lakes exhibiting high algae levels, and both are atypical of the majority of the other lakes sampled in the area, which tended to be slightly acidic with soft water (low ionic strength). The oxygen reduction potential (ORP) readings were well below zero at four meters indicating persistence of the oxygen deficits in the bottom waters.

Other lakes with similar water quality characteristics often support warmwater fisheries, although fisheries habitat cannot be fully evaluated through this monitoring program. Coldwater fisheries are unlikely to be supported, given the lack of cold water and high oxygen refugia necessary to protect any salmonids or aquatic life susceptible to high summer temperatures.

Nitrate and ammonia levels are low, however phosphorus levels were elevated. Chloride and sodium levels were also elevated, indicating possible impacts from road salting and/or other signs of stormwater runoff. It is not known if this results in any ecological impacts.

Aquatic life cannot be fully evaluated though the LCI. The low oxygen levels below four meters in the lake would not be supportive of aquatic life. However, no ecological impacts from the low oxygen levels were observed.

## Evaluation of Water Quality Affects on Lake Uses

### Potable Water (Drinking Water)

Bodine Lake is not classified for use as a potable water supply. Although the LCI data are not sufficient to evaluate potable water use, these data suggest that the lake water would require substantial treatment to serve as potable water supply, due to the elevated levels of algae found in the lake.

### Contact Recreation (Swimming)

Bodine Lake is classified for contact recreation-swimming and bathing. It is believed that the lake may support this use for most of the summer. Bacteria data are needed to evaluate the safety of Bodine Lake for swimming, however these are not collected though the LCI. The data collected though the LCI indicate that swimming can be supported, however the high algae levels seen over the last few years may temporarily cause water clarity readings to drop below the state DOH guidance, of 1.2 meters, to protect the safety of swimmers. Future use of the lake for contact recreation may require management of nutrient sources and reduction of algae levels to insure safe and aesthetically acceptable swimming conditions.

### Non-Contact Recreation (Boating and Fishing)
Non-power boating should continue to be supported on Bodine Lake. Angling should also continue to be supported, although this use cannot be fully evaluated though the LCI program.

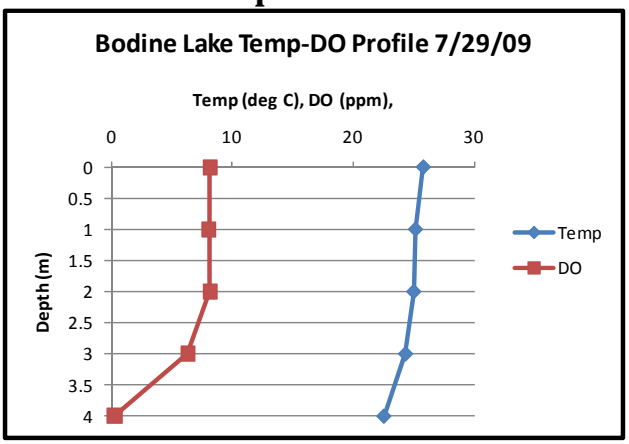
### Aquatic Life
The algal blooms and high phosphorus levels observed in the lake may affect some aquatic organisms (floating and benthic). Additional biological studies would need to be conducted to evaluate aquatic life impacts from reduced oxygen levels in the bottom waters of the lake.

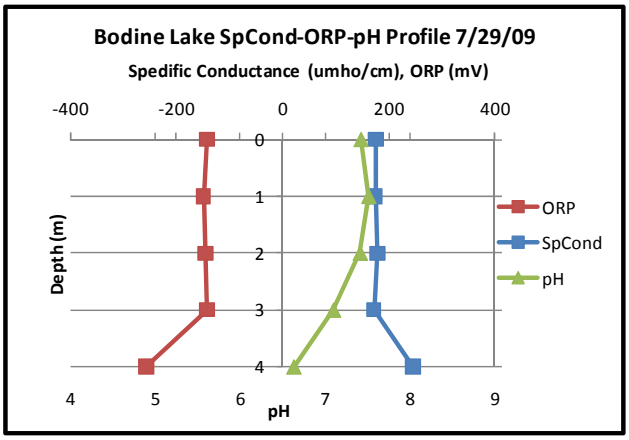
### Aesthetics
Aesthetics may be threatened by excessive algae and these conditions do occasionally affect the existing use of the lake for the purpose of swimming.

## Additional Comments

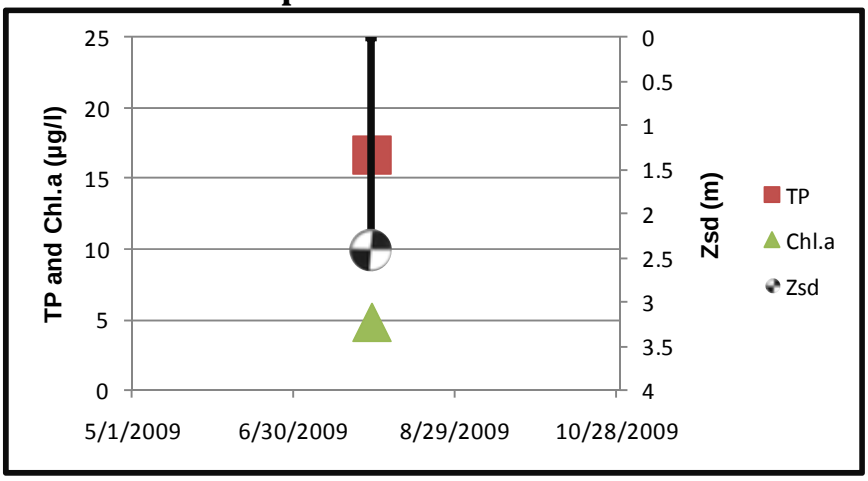
1. Based on DOH analysis of algal samples from 2008, residents should not participate in primary contact recreation (swimming) when algal blooms are observed or immediately following blooms.
2. If Bodine Lake is selected for intensive monitoring in 2010 and any blooms or suspicious conditions are observed during these monitoring efforts additional sampling will be conducted as part of a long-term study by the NYS Department of Health and the NYS Department of Environmental Conservation funded by the Centers for Disease Control, to evaluate the presence and persistence of harmful algal blooms in New York State.
3. 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.
4. Reducing nutrient (phosphorus and nitrogen) loads to the lake may help reduce the occurrence of algal blooms. Nutrients can enter the lake from many different sources including septic systems, stormwater runoff, soil erosion, and fertilizers. The NYSDOH recommends septic systems be inspected and pumped every two to three years. The US Environmental Protection Agency (EPA) has some recommendations regarding stormwater runoff and lawn care and how to reduce fertilizer use. (See references below for more information on septic systems, stormwater runoff and greenscaping.)
5. A water quality assessment was conducted on the tributary that is downstream of Bodine Lake. An initial look at data from this assessment showed that the biological community was slightly impacted with pesticides being a possible cause of the impact. Runoff is a common source of pesticides in waterbodies and as stated above may be contributing to elevated nutrient levels in the lake.
6. Lake residents have expressed some interest in the NY Citizens Statewide Lake Assessment Program (CSLAP), a volunteer lake monitoring program run jointly by the NYSDEC and the NY Federation of Lake Associations (FOLA). Additional information about CSLAP, including application forms for participation, can be found at www.nysfola.org.

## Time Series Depth Profiles




## Time Series: Trophic Indicators



# WQ Sampling Results

## Surface Samples

| | UNITS | Reading | Scientific Classification | Regulatory Comments |
|---|---|---|---|---|
| SECCHI | meters | 2.4 | Mesotrophic | Reading does not violate DOH guidance value |
| TSI-Secchi | | 47.4 | Mesotrophic | No pertinent water quality standards |
| TP | mg/l | 0.0167 | Mesotrophic | Reading does not violate DEC guidance values |
| TSI-TP | | 44.7 | Mesotrophic | No pertinent water quality standards |
| TSP | mg/l | 0.0055 | High % soluble Phosphorus | No pertinent water quality standards |
| NOx | mg/l | 0.0054 | Low nitrate | Reading does not violate guidance |
| NH4 | mg/l | 0.083 | Low ammonia | Reading does not violate guidance |
| TKN | mg/l | 0.32 | Low organic nitrogen | No pertinent water quality standards |
| TN/TP | mg/l | 42.87 | Phosphorus Limited | No pertinent water quality standards |
| CHLA | ug/l | 4.8 | Mesotrophic | No pertinent water quality standards |
| TSI-CHLA | | 46.0 | Mesotrophic | No pertinent water quality standards |
| Alkalinity | mg/l | 10.9 | Poorly Buffered | No pertinent water quality standards |
| TCOLOR | ptu | 5 | Uncolored | No pertinent water quality standards |
| TOC | mg/l | 3.3 | | No pertinent water quality standards |
| Ca | mg/l | 6.41 | Does Not Support Zebra Mussels | No pertinent water quality standards |
| Fe | mg/l | 0.178 | | Reading does not violate water quality standards |
| Mn | mg/l | 0.0389 | | Reading does not violate water quality standards |
| Mg | mg/l | 1.76 | | Reading does not violate water quality standards |
| K | mg/l | 0.688 | | No pertinent water quality standards |
| Na | mg/l | 23.2 | | Reading violates water quality standards |
| Cl | mg/l | 42.3 | Significant road salt runoff | Reading does not violate water quality standards |
| SO4 | mg/l | 4.6 | | Reading does not violate water quality standards |

## Lake Perception

| | UNITS | Reading | Scientific Classification | Regulatory Comments |
|---|---|---|---|---|
| WQ Assessment | 1-5, 1 best | 3 | Definite Algal Greenness | No pertinent water quality standards |
| Weed Assessment | 1-5, 1 best | 3 | Plants Grow to Lake Surface | No pertinent water quality standards |
| Recreational Assessment | 1-5, 1 best | 3 | Slightly Impaired | No pertinent water quality standards |

# Legend Information

## General Legend Information

Surface Samples = integrated sample collected in the first 2 meters of surface water
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.)<br>Detection limit = 1 S.U.; NYS standard = 6.5 and 8.5 |
| SpCond | = specific conductance, corrected to 25ºC, micromho per centimeter (µmho/cm)<br>Detection limit = 1 µmho/cm; no NYS standard or guidance value |
| ORP | = Oxygen Reduction Potential, millivolts (MV)<br>Detection limit = -250 mV; no NYS standard or guidance value |

## Lake Assessment

| | |
|---|---|
| WQ Assessment | **= water quality assessment**, 5 point scale, 1= crystal clear, 2 = not quite crystal clear, 3 = definite algae greenness, 4 = high algae levels, 5 = severely high algae levels |
| Weed Assessment | **= weed coverage/density assessment**, 5 point scale, 1 = no plants visible, 2 = plants below surface, 3 = plants at surface, 4 = plants dense at surface, 5 = plants cover surface |
| Recreational Assessment | **= swimming/aesthetic assessment**, 5 point scale; 1 = could not be nicer, 2 = excellent, 3= slightly impaired, 4 = substantially impaired, 5 = lake not usable |

## References


Cornell University Cooperative Extension. 2009. Septic Systems and Wastewater. <http://waterquality.cce.cornell.edu/septic.htm>.

NYSDOH. 2007. Septic Systems – Operations & Maintenance. <http://www.health.state.ny.us/environmental/outdoors/septic/>.

US EPA. Undated. A Homeowner's Guide to Septic Systems. <http://www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf>.

US EPA. 2003. After the Storm. <http://www.epa.gov/weatherchannel/stormwater.html>.

US EPA Region 2. 2008. Greenscaping. <http://www.epa.gov/region02/p2/greenscaping>.