# LCI Lake Water Quality Summary

General Information

Lake Name: **Bowman Lake**

Location: Bowman Lake State Park, Town of McDonough, Chenango County, New York

Basin: Susquehanna River Basin

Size: 14.8 hectares (37 acres)

Lake Origins: man-made / earthen dam

Major Tributaries: Bowman Creek

Lake Tributary to?: Bowman Creek

Water Quality Classification: C(T) (best intended use: secondary contact recreation). (T) denotes that the waters be suitable for trout survival

Average Sounding Depth: 4.4 meters (14.5 feet)

Sampling Coordinates: Latitude: 42.51632, Longitude: -75.68881

Sampling Access Point: Boat Launch (Bowman Lake State Park)

Monitoring Program: Lake Classification and Inventory (LCI) Survey

Sampling Dates: 6/9/2009, 7/13/2009, 8/11/2009 & 9/8/2009

Samplers: Scott Kishbaugh, NYSDEC Division of Water, Albany
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Lake Map
(sampling location marked with a circle)
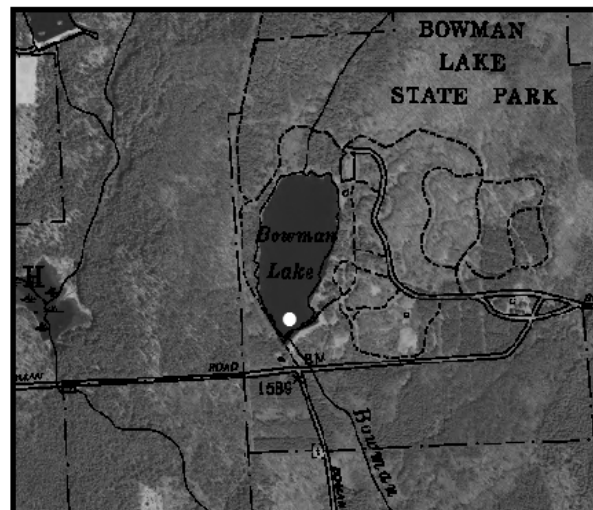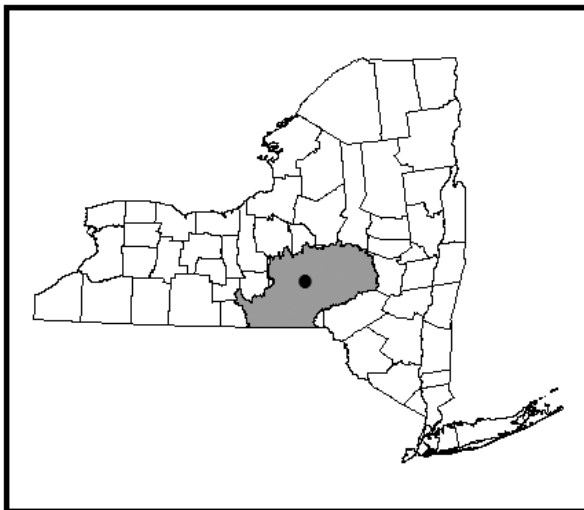
Background and Lake Assessment

Bowman Lake is a 37 acre man made impoundment on Bowman Creek. The lake is one of the main attractions at Bowman Lake State Park, Chenango County. The lake is used by park visitors for swimming, fishing and boating. The park maintains a swimming beach at the northern end of the pond and a hand carry boat launch/ parking area for non-motorized boats at the opposite end of the lake. The pond's watershed is almost entirely forested with the upper reaches of the watershed lying within the McDonough State Forest. The beach was closed during portions of the summer of 2009 due to the presence an algal bloom. Bowman Lake was included in the 2009 Lake Classification and Inventory (LCI) intensive survey of the Susquehanna River Basin at the request of the State Office of Parks Recreation and Historic Preservation (OPRHP).

Bowman Lake can generally be characterized as *eutrophic*, or highly productive. The average water clarity reading (TSI = 55, typical of *eutrophic* lakes) was expected given the average phosphorus reading (TSI = 53, typical of *eutrophic* lakes), and the average chlorophyll *a* reading (TSI = 56, typical of *eutrophic* lakes). These data and visual observations indicate that algal blooms were occurring during the August and September sampling events, and that baseline nutrient levels are high enough to support persistent algal blooms in the lake.

Algal greenness was apparent to the samplers during the July, August and September sampling events. An assessment of the plant community showed that the invasive species *Myriophyllum spicatum* (Eurasian watermilfoil) is growing in the lake. The native macrophytes *Elodea Canadensis* (common waterweed), *Ranunculus sp.* (water crowfoot), and *Sparganium sp.* (bur reed) were also observed to be growing in the lake.

Water samples were collected to evaluate the potential presence of harmful algal blooms—cyanobacteria that might trigger the release of algal toxins or taste and odor compounds. The samples from Bowman Lake were run through a phycocyanin detector and recorded readings of 3 phycocyanin units from the July sample. Results from the August and September samples had not been provided by NYSDOH at the time of this writing. Any sampling results below 100 units 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. It is not yet known what phycocyanin readings might result in microcystis-LR readings above 5-10 µg/l, the guidance to protect contact recreation. The results from these detectors can be highly variable, and should only be used as an indication of a potential problem.

Like most shallow water bodies, Bowman Lake was not thermally stratified. Temperature and dissolved oxygen readings were comparable throughout the water column. However, the September depth profile did show a drop in dissolved oxygen in the bottom two meters of the pond, which may be related to the decomposition of algae related to the algal bloom. pH readings indicate alkaline waters from July through September. Alkaline conditions are often associated with high levels of algae. Conductivity readings indicate soft water (low ionic strength).

Bowman Lake appears to be typical of softwater, uncolored, alkaline lakes. Other lakes with similar water quality characteristics often support warmwater fisheries, although fisheries habitat cannot be fully evaluated through this monitoring program. Stocked coldwater fish species may not survive the high summer temperatures. It is not known if springs or other temperature refugia exist to protect any salmonids or other aquatic life susceptible to high summer temperatures. The water quality classification of class C(T) suggest that before the lake was created that trout were surviving in Bowman Creek.

Total phosphorus levels exceeded the state's guidance value during the July through September sampling events. It was determined that, as in most NYS lakes, phosphorus is the liming nutrient for algal production. The increase in total phosphorus levels throughout the summer was consistent with the increase in chlorophyll *a* (algae). Chloride and other ion levels were either below the laboratories detection limit or found in low concentrations. This is typically seen in water bodies in highly forested watersheds that lack development.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)
Bowman 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 a potable water supply, due to the high algae levels in the lake as well as elevated phosphorus, iron, magnesium and manganese levels.

Contact Recreation (Swimming)
Bowman Lake is not classified for contact recreation although OPRHP currently operates a swimming beach when conditions are suitable for swimming. The New York State Water Quality Classification of *Class C* states that "water quality shall be suitable for primary contact recreation, although other factors may limit the use for this purpose". Bacteria data are needed to evaluate the safety of Bowman Lake for swimming; however, these are not collected through the LCI. OPRHP does collect these data at the swimming beach. The water chemistry data collected through the LCI indicate that swimming may be *impaired* by excessive algae and poor water clarity, due to elevated nutrient levels. Water clarity readings outside of algal blooms meet the DOH swimmer safely guidance value of 1.2 meters. However, during the algal bloom, observed in August and September, water clarity fell below the state DOH guidance value. The presence of Eurasian watermilfoil may also make swimming difficult if the plant is able to reach high densities near the swimming beach. Continued use of the lake for contact recreation may require management of Eurasian watermilfoil, and nutrient sources should be identified and managed to reduce algal blooms and provide safe and aesthetically acceptable swimming conditions.

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. If any algal blooms are suspected at Bowman Lake in the future, the Chenango County Health Department should be notified to conduct additional investigations to determine if restrictions on drinking or swimming in lake water may be appropriate.

Non-Contact Recreation (Boating and Fishing)
Bowman Lake is classified for non-contact recreation, and does currently support this use. Non-motorized boating and fishing should continue to be supported. The OPRHP website for the park indicates that trout are stocked in the lake.

Aquatic Life
High algal levels observed in the lake during the late summer may affect some aquatic organisms (floating and benthic). Additional biological studies would need to be conducted to evaluate aquatic life impacts due to the late season algal blooms

Aesthetics
These data indicate that aesthetics may be *threatened* by excessive algae levels in the late summer.

Additional Comments
1. 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.
2. Algae identification would determine if the lake may suffer from harmful algal blooms (HABs) and/or the production of algal toxins. This may be conducted through future generations of the LCI or on-going monitoring conducted by NYSOPRHP. In the interim, if any algal blooms are suspected at Trout Pond in the future, the Chenango County Health Department should be notified to conduct additional investigations to determine if restrictions on drinking or swimming in lake water may be appropriate.
3. Tracking and reducing the source(s) of phosphorus inputs to the lake may help limit the occurrence of algal blooms in the lake.

Aquatic Plant IDs
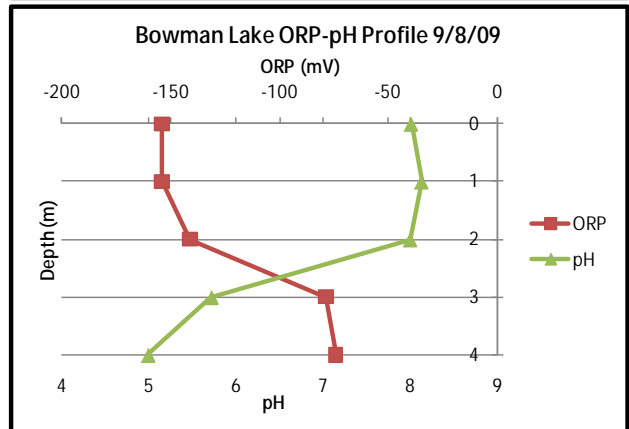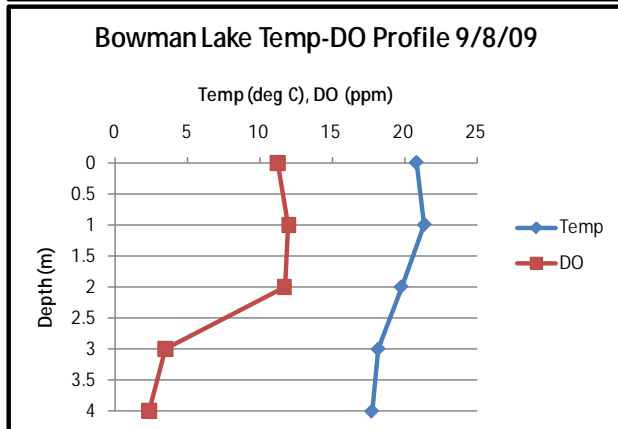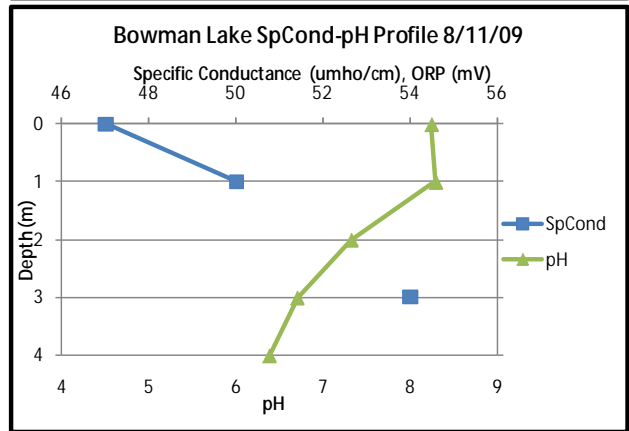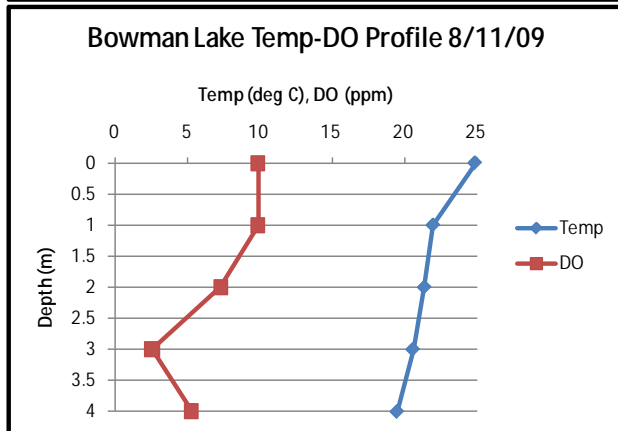Exotic Plants: *Myriophyllum spicatum* (Eurasian watermilfoil)
Native Plants: *Elodea canadensis* (common waterweed)
                            Ranunculus sp. (water crowfoot)
                            Sparganium sp. (bur reed)

Time Series: Depth Profiles

Bowman Lake Temp-DO Profile 6/9/09

Bowman Lake SpCond-ORP-pH Profile 6/9/09

Bowman Lake Temp-DO Profile 7/13/09

Bowman Lake SpCond-pH Profile 7/13/09

Bowman Lake Temp-DO Profile 8/11/09

Bowman Lake SpCond-pH Profile 8/11/09

Bowman Lake Temp-DO Profile 9/8/09

Bowman Lake ORP-pH Profile 9/8/09
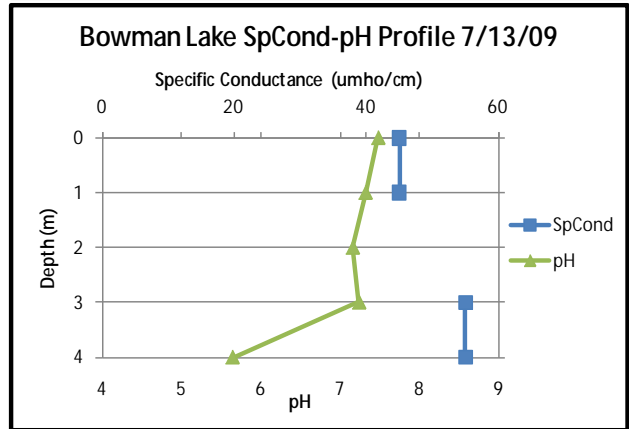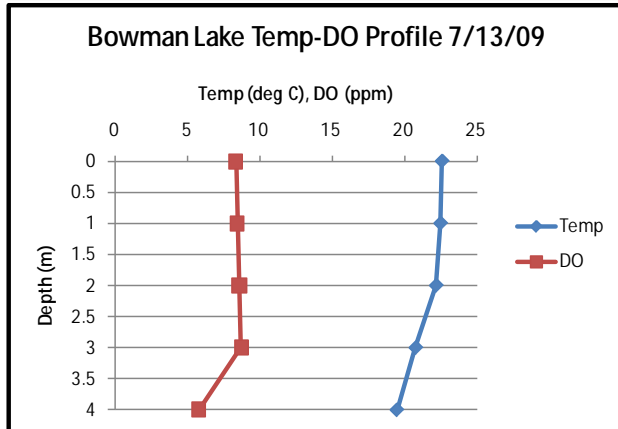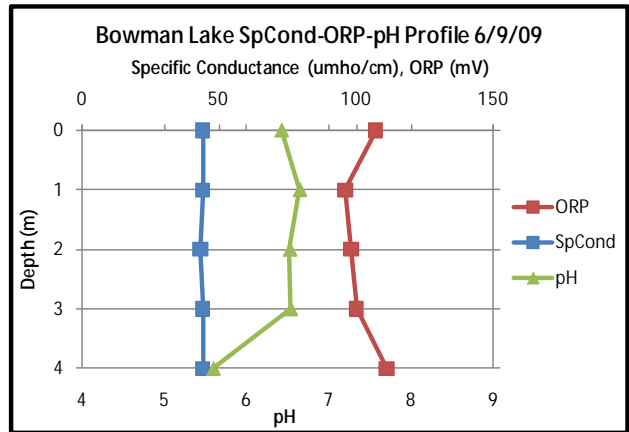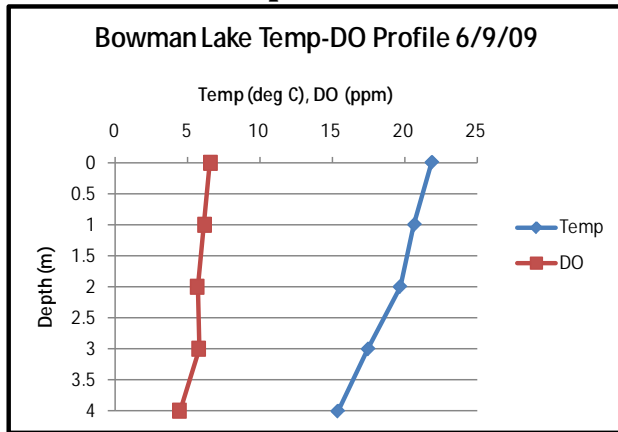
Time Series: Trophic Indicators
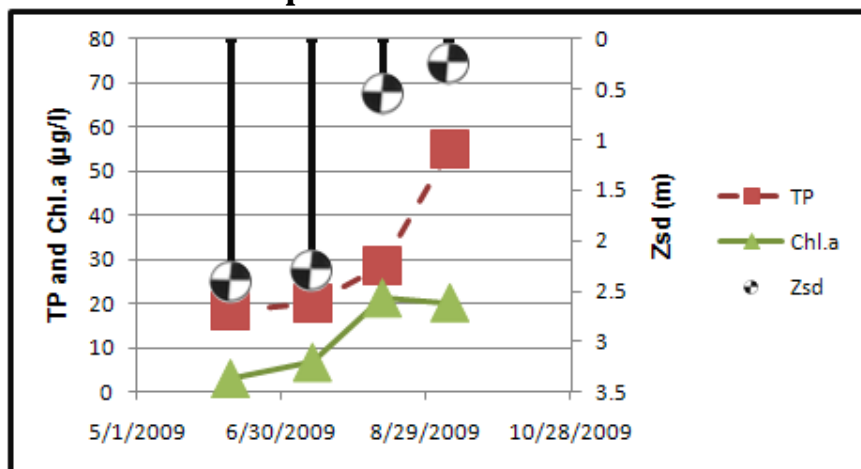
WQ Sampling Results

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	4	0.25	1.38	2.4	Eutrophic	50% of readings violate DOH guidelines
TSI-Secchi			80.0	55.4	47.4	Eutrophic	No pertinent water quality standards
TP	mg/l	4	0.0182	0.0305	0.0548	Eutrophic	75% of readings violate DOH guidelines
TSI-TP			46.0	53.4	61.8	Eutrophic	No pertinent water quality standards
TSP	mg/l	4	0.0047	0.0155	0.0345	High % soluble Phosphorus	No pertinent water quality standards
NOx	mg/l	4	0.0043	0.0082	0.0156	Low nitrate	No readings violate DOH guidance value
NH4	mg/l	4	ND	0.018*	0.026	Low ammonia	No readings violate DOH guidance value
TKN	mg/l	4	0.38	0.78	1.32	Elevated organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	4	41.85	56.22	71.76	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	4	3.2	12.95	21.4	Eutrophic	No pertinent water quality standards
TSI-CHLA			42.0	55.7	60.7	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	4	13.1	16.7	20.2	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	4	5	12.5	20	Uncolored	No pertinent water quality standards
TOC	mg/l	4	3.9	4.7	5.9		No pertinent water quality standards
Ca	mg/l	4	5.91	6.9	7.95	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	4	0.102	0.161	0.264		No readings violate DOH guidance value
Mn	mg/l	4	0.0184	0.0288	0.0382		No readings violate DOH guidance value
Mg	mg/l	4	0.741	0.88	0.978		No readings violate DOH guidance value
K	mg/l	4	0.309	0.38	0.514		No pertinent water quality standards
Na	mg/l	4	0.763	0.93	1.02		No readings violate DOH guidance value
Cl	mg/l	4	ND	ND	ND	Little impact from road salt	No readings violate DOH guidance value
SO4	mg/l	4	4.4	4.98	5.5		No readings violate DOH guidance value

* The ammonia average was calculated with non-detects being treated as equal to half the detection limit or 0.005 mg/l.

Lake Perception

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
WQ Assessment	1-5, 1 best	4	2	4	5	High Algae Levels	No pertinent water quality standards
Weed Assessment	1-5, 1 best	4	2	2.75	4	Plants Grow to Lake Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	4	2	3	4	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
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

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