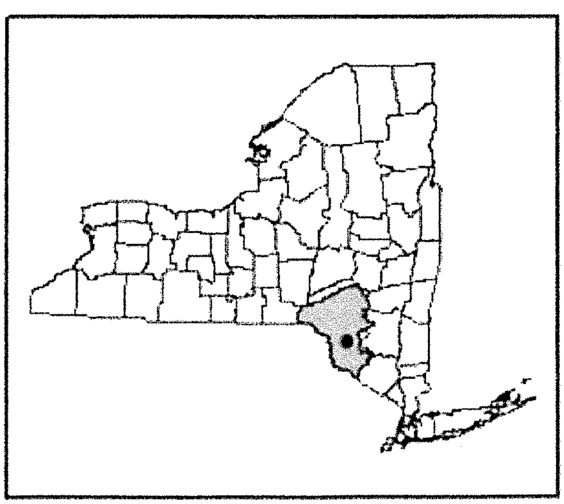
LCI Lake Water Quality Summary

General Information

Lake Name:	**Swan Lake**
Location:	Town of Liberty, Sullivan County, NY
Basin:	Delaware River Basin
Size:	134.7 hectares (333 acres)
Lake Origins:	man-made stone dam erected in 1894
Major Tributaries:	West Branch of the Mongaup River and other minor unnamed tributaries
Lake Tributary to?:	West Branch of the Mongaup River
Water Quality Classification:	B (best intended use: primary contact recreation)
Sounding Depth:	3.2 meters (10.5 feet)
Sampling Coordinates:	Latitude: 41.7569, Longitude: -74.78734
Sampling Access Point:	Roadside launch, southeast corner of lake
Monitoring Program:	Lake Classification and Inventory (LCI) Survey
Sampling Date:	July 28, 2009
Samplers:	Scott Kishbaugh, NYSDEC Division of Water, Albany Dan Hayes, NYSDEC Division of Water, Albany
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

Swan Lake is a large (333 acre) narrow shallow impoundment on the West Branch of the Mongaup River, southwest of the town of Liberty. The lake has several homes and summer camps along portions of the lake shoreline, while other areas of the shoreline are forested. The lake is used for fishing and boating by lake shore residents; it is not known if the lake presently supports swimming. The lake's watershed has a mix of land uses, including low density residential developments, agricultural land, and forested land.

The lake was included in the New York State DEC Division of Water's 2009 screening (single sampling) Lake Classification and Inventory (LCI) survey of the Delaware River Basin. Inclusion was based on an inquiry from a local resident on aquatic weed problems in the lake. Water chestnut, an invasive aquatic weed, had been found at the pond's outlet by DEC Division of Water staff in 2005. Additionally, Swan Lake was listed as "Needs Verification" in the 2001 Delaware River Basin Waterbody Inventory and Priority Waterbodies List (WIPWL). The WIPWL indicates aquatic life and recreation may be stressed in the lake due to eutrophic conditions, possibly related to a municipal discharge. Due to elevated phosphorus levels and the WIPWL listing, Swan Lake is a candidate for additional monitoring during the summer of 2010.

Based on the data collected in 2009 Swan Lake can generally be characterized as *eutrophic*, or highly productive. The water clarity reading (TSI = 65, typical of *eutrophic* lakes) was expected given the phosphorus reading (TSI = 59, typical of *eutrophic* lakes) and the chlorophyll *a* reading (TSI = 62, typical of *eutrophic* lakes). These data indicate that an algal bloom was occurring and that baseline nutrient levels may support persistent algal blooms during the summer.

Algal greenness was probably visible to the casual observer and an algal bloom was apparent to the samplers. Several species of rooted aquatic plants were observed on the lake including two exotic invasive species: *Trapa natans* (water chestnut) and *Potamogeton crispus* (curly leaf pondweed). Profiles of both of these species are included below. Water chestnut is common to the Lower Hudson River basin and in other regions of the state, but has not been observed in many lakes in the Delaware River basin. The native plant species observed included: *Vallisneria americanum* (eel grass), *Potamogeton amplifolius* (large leaf pondweed), *Elodea canadensis* (common waterweed), *Potamogeton foliosus* (leafy pondweed), and *Nuphar sp* (yellow water lily). All of the native species are commonly found in other water bodies throughout the Delaware River Basin.

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 Swan Lake were run through a phycocyanin detector and recorded readings of above the analytical detection limit (>2000 phycocyanin units). Any sampling results above 100 units may be associated with the presence of more 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, Swan Lake was not thermally stratified. Temperature readings were comparable throughout the water column. There was a large drop in the dissolved oxygen levels below about 2 meters in the lake. Oxygen deficits are typically seen in water bodies that have high levels of algal production and decomposition. pH readings indicate alkaline water, and conductivity readings indicate soft water (low ionic strength). The pH reading was above the state's guidance value. High pH values are typically seen in lakes with high levels of algae. Soft water is typical for water bodies in the Delaware River Basin.

The lake appears to be typical of shallow softwater, weakly colored, alkaline lakes. Other lakes with similar water quality characteristics often support warmwater fisheries, although fisheries habitat cannot be fully evaluated thought this monitoring program. Cold water fisheries may not be supported, given the lack of cold oxygen rich water during the summer. It is not known if springs or other temperature refugia exist to protect any salmonids of aquatic life susceptible to high summer temperatures.

Chloride levels indicate moderate impacts from road salting and/or runoff from developed areas. Iron levels were above the state guidance value; elevated iron levels are seen in lakes that experience oxygen deficits due to high levels of algae. No other water quality parameters evaluated through the LCI indicate water quality issues.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Swan 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 lake water would require substantial treatment to serve as a potable water supply due to the high levels of phosphorus, algae, iron, and elevated pH.

Contact Recreation (Swimming)

Swan Lake is classified for contact recreation, although it is not known if people actively swim in the lake. Bacteria data are needed to evaluate the safety of Swan Lake for swimming—these are not collected through the LCI. The data collected through the LCI indicate that the lake may be unsafe for swimming, as the water clarity reading was below the State Department of Health's guidance value of 1.2 meters to protect the safety of swimmers. In addition, the high levels of algae and aquatic plants may discourage people from swimming in the lake.

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 Swan Lake in the future, the Sullivan County Health Department should be notified to conduct additional investigations to determine if restrictions on drinking or swimming in lake water may be appropriate. This will also be evaluated if Swan Lake is included in the 2010 LCI sampling program, pending the available of funds to support their inclusion.

Non-Contact Recreation (Boating and Fishing)

These data indicate that non-contact recreation may be threatened by excessive aquatic vegetation. The high levels of algae may be causing reduction in dissolved oxygen levels which may stress some fish species; in addition, the elevated pH level may stress some fish species.

Aquatic Life

The reduced levels of dissolved oxygen below 2 meters in the lake may stress some aquatic life; the elevated pH level may also stress aquatic life. A more detailed biological survey would need to be conducted to fully evaluate stressors to aquatic life in the lake.

Aesthetics

These data indicate that aesthetics may be threatened by excessive algae, reduced water clarity and high densities of aquatic macrophytes.

Additional Comments

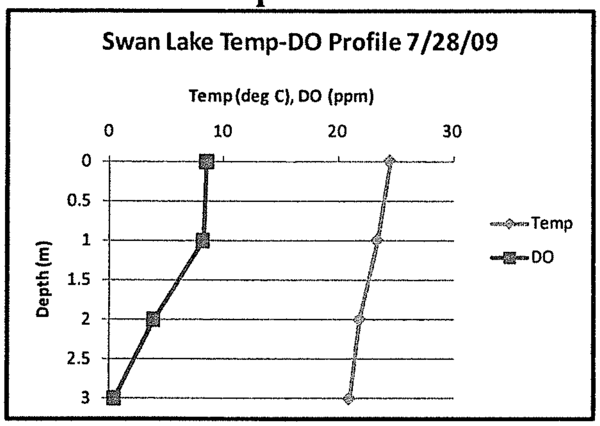
1. Identifying and reducing the sources of nutrient levels may help prevent algal blooms. Residence of the lake community should minimize the use of fertilizers used on lawns and insure that septic systems are properly installed and functioning correctly.
2. Periodic surveillance for invasive exotic plant species may help to prevent the establishment and spread of any new invaders, given the escalating problems with exotic aquatic weeds. The lake community should consider taking steps to manage the water chestnut population in the lake. Some of the most appropriate measures are discussed in the water chestnut chapter (13.3) in the AERF aquatic plant control manual, found at http://www.aquatics.org/bmp.htm. This chapter was written with specific recognition of management techniques and permitting issues associated with New York State, although the NYSDEC Region 3 permitting offices (r3dep@gw.dec.state.ny.us) should also be consulted should any biological or chemical means for controlling the plant be considered.
3. Algae identification would determine if the lake may suffer from harmful algal blooms (HABs) and/or the production of algal toxins. Additional sampling will be conducted in 2010 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.

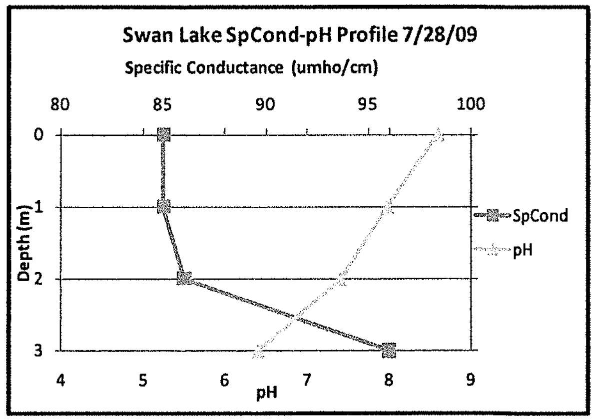
Aquatic Plant IDs

Exotic Plants: *Trapa natans* (water chestnut)
Potamogeton crispus (curly leaf pondweed)

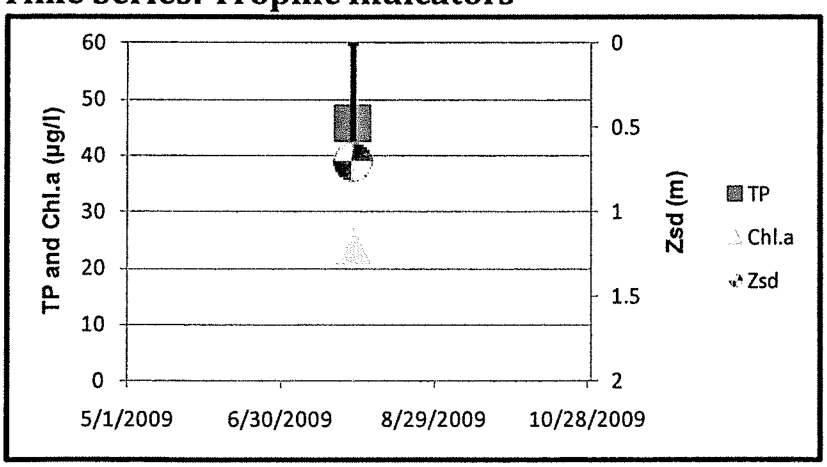
Native Plants: *Vallisneria americanum* (eel grass)
Potamogeton amplifolius (large leaf pondweed)
Elodea canadensis (common waterweed)
Potamogeton foliosus (leafy pondweed)
Nuphar sp. (yellow water lily)

Time Series: Depth Profiles





Time Series: Trophic Indicators



WQ Sampling Results

Surface Samples

	UNITS	Reading	Scientific Classification	Regulatory Comments
SECCHI	meters	0.7	Eutrophic	Reading violates DOH guidelines
TSI-Secchi		65.1	Eutrophic	No pertinent water quality standards
TP	mg/l	0.0457	Eutrophic	Sample exceeds guidance value
TSI-TP		59.2	Eutrophic	No pertinent water quality standards
TSP	mg/l	0.0417	High % soluble Phosphorus	No pertinent water quality standards
NOx	mg/l	0.0063	Low nitrate	Reading does not violate guidance
NH4	mg/l	0.044	Low ammonia	Reading does not violate guidance
TKN	mg/l	0.74	Intermediate organic nitrogen	No pertinent water quality standards
TN/TP	mg/l	35.93	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	24	Eutrophic	No pertinent water quality standards
TSI-CHLA		61.8	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	15.9	Poorly Buffered	No pertinent water quality standards
TCOLOR	ptu	30	Weakly Colored	No pertinent water quality standards
TOC	mg/l	6.7		No pertinent water quality standards
Ca	mg/l	7.29	Does Not Support Zebra Mussels	No pertinent water quality standards
Fe	mg/l	0.503	Taste or odor likely	Reading violates water quality standards
Mn	mg/l	0.139		Reading does not violate water quality standards
Mg	mg/l	0.958		Reading does not violate water quality standards
K	mg/l	0.364		No pertinent water quality standards
Na	mg/l	9.36		Reading does not violate water quality standards
Cl	mg/l	14.3	Moderate road salt runoff	Reading does not violate water quality standards
SO4	mg/l	3.4		Reading does not violate water quality standards

Lake Perception

	UNITS	Reading	Scientific Classification	Regulatory Comments
WQ Assessment	1-5, 1 best	4	High Algae Levels	No pertinent water quality standards
Weed Assessment	1-5, 1 best	4	Dense Plant Growth at Lake Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	4	Substantially 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.) Detection limit = 1 S.U.; NYS standard = 6.5 and 8.5
SpCond	= specific conductance, corrected to 25°C, 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

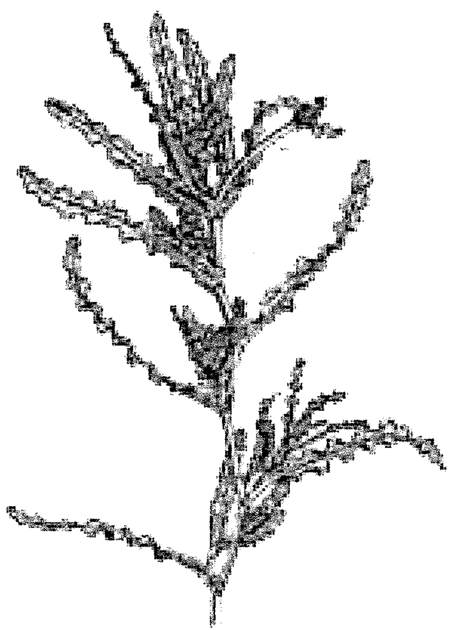
WQ Assessment	= **water quality assessment**, 5 point scale, 1= crystal clear, 2 = not quite crystal clear, 3 = definite algae greenness, 4 = high algae levels, 5 = severely high algae levels
Weed Assessment	= **weed coverage/density assessment**, 5 point scale, 1 = no plants visible, 2 = plants below 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

Invasive Plant Profiles

SPECIES NAME: *Potamogeton crispus*

COMMON NAME: curlyleaf pondweed

ECOLOGICAL VALUE: While this is not a native plant to New York state, it has become well established in many lakes and does not disrupt the aquatic ecosystem as do other (recently-introduced) exotics, although it still can out-compete native species and dominate a macrophyte community, particularly in late spring and early summer (before the peak growing season for other native and non-native macrophytes).



DISTRIBUTION IN UNITED STATES: In hard or brackish, often polluted waters, naturalized from Europe and common in New England, western Massachusetts, with a range extending from Quebec west to Minnesota, south to Alabama and Texas, and scattered throughout the western states

DISTRIBUTION IN NEW YORK: widespread and often abundant along the Hudson River and Finger Lakes basins, with some occurrences in far western New York

DEGREE OF NUISANCE: *Potamogeton crispus* may establish easily and grow abundantly, reaching nuisance levels, although the extent of coverage and nuisance conditions is limited by the growing season (winter through early-mid summer)

COMMENTS: *Potamogeton* is a highly variable genus within the pondweed family. Species within the genus often are characterized by two leaf types- firm floating leaves and thin emersed leaves. Many mature species have flowers borne in spikes (for wind pollination), conspicuous in early summer. Identification of the individual species can be extremely difficult, particularly among the narrow-leaved pondweeds. The *Potamogeton* are distinguished from the other genus within the pondweed family by having alternate leaves (unlike the *Zanichellia* and *Najas*), and by their presence in fresh or estuarine waters (unlike the *Zostera*). There are nearly 30 species found within New York State, some quite rare and others extremely common. *P. crispus* is one of the four major non-native exotic plant species in New York state, and has served as the impetus for several lake restoration and plant management programs. However, it naturally dies out in many lakes by early to mid summer, often to be replaced by other monocultures. It is characterized by finely-toothed leaf margins and a 'lasagna'-like leaf appearance.

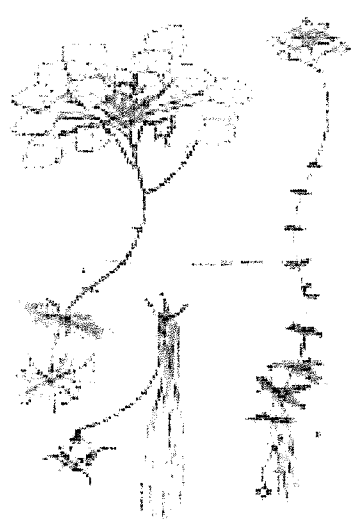
Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000

SPECIES NAME: *Trapa natans*

COMMON NAME: water chestnut

ECOLOGICAL VALUE: like all floating plants, *Trapa* harbor aquatic insects, and there is some evidence that water chestnut also provide an excellent habitat for small fish. However, for the most part, *Trapa* does not possess great ecological value. It is a poor food producer and shelter for most aquatic organisms. The nuts are not utilized by wildlife, and infestations are detrimental to water flow.

DEGREE OF NUISANCE: *Trapa* is a non-native plant to New York, and, as such, can dominate a plant community when introduced. In some areas of the state, it constitutes a major nuisance, affecting recreational use and aesthetic enjoyment of the water. In other areas, it remains less of a problem, due at least to some degree to the vigilant control (usually by hand-pulling) exerted once a bed is located. At present, it is far more common in major navigable rivers (such as the Mohawk and Hudson Rivers) or major lakes (such as Lake Champlain) than in small inland lakes



DISTRIBUTION IN UNITED STATES: it is locally abundant, sometimes forming large floating mats, in the soft mud of lakes, ponds, and sluggish river tributaries in most of the New England and Atlantic States, ranging from Massachusetts to western Vermont, eastern New York, Maryland, and Virginia

DISTRIBUTION IN NEW YORK: this plant is limited primarily to lakes hydrologically connected to Lake Champlain and the Hudson River, although increasingly appearing in other lakes in these drainage basins and throughout eastern New York to Oneida Lake (along the Barge Canal and the Mohawk River). It has been identified in Long Island. As noted above, however, it is still more frequently found in rivers than in lakes.

COMMENTS: *Trapa* is one of the four major nuisance exotic plants in New York State. It was introduced to North America around 1874, and one of the first documented introductions in the United States was in Collins Lake in Schenectady in 1884. It is an annual, overwintering by seeds, and forming a rosette of flowers by early summer. The flowers produce sharp horned nuts that can inflict painful wounds at bathing beaches. As a non-native plant, it often outcompetes other vegetation, forming impenetrable mats that hinder transportation and fishing. As such, it has been the subject of extensive aquatic vegetation control strategies. The importation, transportation or cultivation of this plant is prohibited by state and federal law. One species of this genus is found in New York.

Line drawing- Crowe, G.E. and C.B. Hellquist. Aquatic and wetlands plants of northeastern North America. 2000