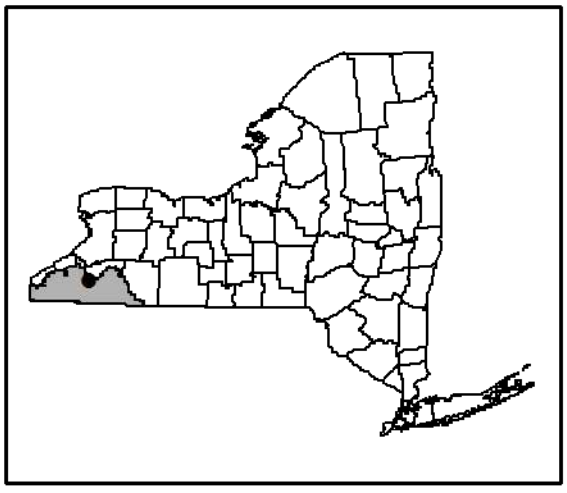
LCI Lake Water Quality Summary

General Information

Lake Name:	**Linlyco Lake**
Location:	Town of New Albion, Cattaraugus County, NY
Basin:	Allegheny River Basin
Size:	4.5 hectares (11 acres)
Lake Origins:	Earthen Dam
Tributaries:	Minor unnamed tributary to Little Valley Creek
Watershed Area:	approximately 1.0 mi^2
Lake Tributary to:	Little Valley Creek
Water Quality Classification:	B(T) (best intended use: primary contact recreation) (T) waters shall be suitable for trout survival
Sounding Depth:	1.3 meters (4 feet)
Sampling Coordinates:	42.27255, -78.8306
Sampling Access Point:	Private land (Mannheim)
Monitoring Program:	Lake Classification and Inventory (LCI) Survey
Sampling Date:	8/3/2011, 6/26, 8/1 & 8/29/2012
Samplers:	David Newman, Brad Wenskoski, & Scott Kishbaugh, NYSDEC Division of Water, Albany Brian Hourigan, NYSDEC Division of Water, Buffalo
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

Linlyco Lake is a small waterbody between the villages of Little Valley and New Albion in Cattaraugus County. The northern and southern shorelines of the lake are developed with both seasonal and year round homes. A few properties have old boat docks, and many of the properties on the lake have manicured lawns that run up to the lake. The western and eastern sides of the lake are forested. Both a road and a railroad grade, which has been converted to a rail-trail, bisect the lake. The larger watershed is predominately forested with a small amount of agricultural land in the upper reaches of the watershed. The observation of old boat docks suggest that at one time the lake supported boating, fishing and possibly swimming.

The NYSDEC Division of Water's lake water quality database had no previous data for the lake, and thus the lake was included in the 2011 Lake Classification and Inventory (LCI) screening program. Due to low water clarity, high nutrient levels and the occurrence of an algal bloom, additional monitoring of the lake took place during the summer of 2012.

Linlyco Lake can be generally characterized as *eutrophic*, or highly productive. The average water clarity reading from samples taken in 2011 and 2012 (TSI = 62, typical of *eutrophic* waterbodies) was in the expected range given the total phosphorus average reading (TSI = 63, typical of *eutrophic* waterbodies) and the chlorophyll *a* reading (TSI = 65, typical of *eutrophic* waterbodies). These data indicate that the lake may support persistent algal blooms, similar to the bloom that was occurring in early August of 2011.

In August of 2011 the lakes had a green coloration with very low water clarity (0.4m) and a high total phosphorus level. These conditions are typical of lakes experiencing algal blooms. A water sample taken in August of 2011 from the lake was analyzed for the presence of toxin producing algae species as well as for the concentration of specific algal toxins. This sample showed that a toxin producing algae (*Anabaena*) was present in the sample, but that the toxin concentration was below the existing guidelines for protecting swimming. Conditions seen at the lake in 2012 were not quite as severe; water clarity in late June and late August exceeded 1 meter, and the early August reading was nearly 1 meter. Chlorophyll *a* and phosphorus levels were high throughout 2012, but were lower than the early August 2011 levels (see chart below). Water clarity, total phosphorus and chlorophyll *a* levels typically did not meet water quality standards and guidance values during 2011 and 2012.

Two exotic invasive plant species were found in the lake in late June of 2012: Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*). Both are known to grow to high densities and outcompete native aquatic plants. Two native plant species were also observed to be growing in the lake. However, overall rooted aquatic plant growth in the lake was low, with no evidence of surface weeds.

Small shallow unmanaged lakes like Linlyco often exist in one of two "Alternate Stable States". In these alternate stable states the lakes either have relatively clear water with dense populations of aquatic plants and limited algae production, or have low water clarity, low densities of aquatic plants and high algae levels. The latter was the only state observed during each sampling session.

Like most shallow lakes, Linlyco Lake does not exhibit thermal stratification, in which depth zones (warm water on top, cold water on the bottom during the summer) are established during the summer. Field parameters taken at the surface of the lake were similar on all four sampling dates. pH readings were slightly alkaline, which is common in highly productive lakes. Conductivity readings indicate hard water (high ionic strength), which was also seen at other nearby lakes and is probably typical for the area.

Linlyco Lake appears typical of other shallow *eutrophic* waterbodies. While the LCI cannot fully evaluate fisheries habitat, similar waterbodies tend to support warmwater fish communities with a limited number of the large piscivorous fish (fish that eat smaller fish). Due to the shallow nature of the lake, summer water temperatures are above the optimum range for coldwater fish species, so the lake is unlikely to support coldwater fish populations.

Iron and manganese levels were above the state's water quality standard in all samples that were collected and would likely cause taste or odor problems if the lake was being used as a water supply. The chloride levels were below the water quality standard; however, the levels were high enough to suspect external inputs to the lake, such as road salt runoff or failing septic systems. None of the other water quality parameters that were evaluated were above the state's water quality standards or guidance values.

Evaluation of Lake Condition Impacts to Lake Uses

Potable Water (Drinking Water)

Linlyco 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 water from the lake would require substantial treatment to serve as a potable water supply due to the elevated manganese, iron and phosphorus levels. In addition, the presence of the high algae levels generally, and the blue-green algae *Anabaena* specifically, is a concern for any "non-regulated" potable water supply use of the lake.

Contact Recreation (Swimming)

Linlyco Lake is classified for primary contact recreation- swimming and bathing being the best intended use. Bacteria data are needed to fully evaluate the safety of Linlyco Lake for swimming—these are not collected through the LCI. The data collected through the LCI indicates that the use of the lake for swimming is known to be *impaired* by low water clarity, excessive algae, and the presence of *Anabaena* (blue green algal) blooms, and is *threatened* by high phosphorus levels. LCI staff indicated that the recreational potential for the lake was *slightly* to *substantially impaired.*

Non-Contact Recreation (Boating and Fishing)

The data collected through the LCI indicate that non-contact recreation is *threatened* by occurrence of Eurasian watermilfoil and curlyleaf pondweed, both of which are invasive exotic plant species.

Aquatic Life
As the lake is not deep enough to thermally stratify, it may not support organisms susceptible to high summer temperatures. Although the lake is classified for trout survival, it is unlikely that the lake ever supported trout or other cold water organisms during the summer months, except in areas associated with coldwater springs. The occurrence of Eurasian watermilfoil and curlyleaf pondweed may *threaten* aquatic communities within the lake due to their ability to outcompete native plant species.

Aesthetics
These data indicate that aesthetics are *stressed* by algal blooms and low water clarity.

Additional Comments

- Identifying and reducing the sources of nutrient levels may help prevent future algal blooms. Individuals with property bordering the lake should minimize the use of fertilizers and insure that septic systems are properly installed and maintained.
- The Cattaraugus County Department of Health should be notified of any future algal blooms in the lake, so they can conduct additional investigations to determine if advice should be provided regarding restrictions on swimming in the lake.
- 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.
- For the majority of the analytes tested for through the LCI program, readings were the highest from the 2011 sample. It is likely that the conditions seen in August of 2011 were not typical for the lake and may have been related to heavy rainfall or other unusual weather conditions.

Aquatic Plant IDs

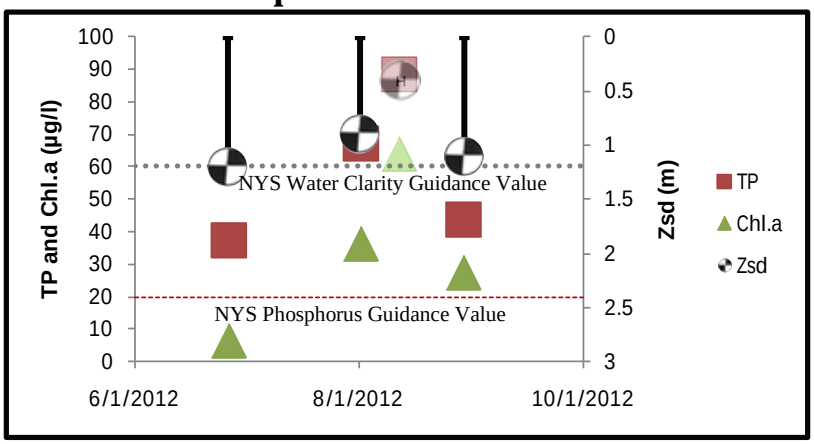
Exotic Plants:	*Myriophyllum spicatum* (Eurasian watermilfoil)
	Potamogeton crispus (curlyleaf pondweed)
Native Plants:	*Elodea canadensis* (common waterweed)
	Najas flexilis (slender naiad)

Field Parameters

Date	Temp. (deg c)	D.O. (mg/l)	pH (pH units)	SpCond (umhos/cm)	ORP (millivolts)
08/03/2011	24.70	7.30	8.17	241.00	180.00
06/26/2012	22.40	7.90	8.47	170.70	343.00
08/01/2012	25.01	7.80	7.69	186.90	322.00
08/29/2012	23.12	9.42	8.60	199.30	301.00

*all readings were taken from just below the surface of the water.

Time Series: Trophic Indicators



*transparent symbols represent readings from 8/3/2011

Water Quality Sampling Results

Surface Samples

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
SECCHI	meters	4	0.4	0.9	1.2	Eutrophic	**75% of readings violate DOH guidelines**
TSI-Secchi			73.2	61.5	57.4	Eutrophic	No pertinent water quality standards
TP	mg/l	4	0.0374	0.0591	0.0883	Eutrophic	**100% of readings violate water quality guidance value**
TSI-TP			56.3	62.9	68.7	Eutrophic	No pertinent water quality standards
TSP	mg/l	4	0.0071	0.01095	0.0165	Little available phosphorus	No pertinent water quality standards
NOx	mg/l	4	0.0036	0.006825	0.0135	Low nitrate	No readings violate water quality standards
NH4	mg/l	4	ND	0.016	0.042	Low ammonia	No readings violate water quality standards
TKN	mg/l	4	0.56	0.9775	2.07	Elevated organic nitrogen	No pertinent water quality standards
TN/TP	mg/l		21.20	34.75	51.67	Phosphorus Limited	No pertinent water quality standards
CHLA	ug/l	4	6.5	33.625	64.1	Eutrophic	No pertinent water quality standards
TSI-CHLA			49.0	65.1	71.4	Eutrophic	No pertinent water quality standards
Alkalinity	mg/l	4	55	74.5	102	Moderately Buffered	No pertinent water quality standards
TCOLOR	ptu	4	12	27.5	34	Weakly Colored	No pertinent water quality standards
TOC	mg/l	4	4.5	6.6	11.3		No pertinent water quality standards
Ca	mg/l	4	17.6	22.25	26.9	Minimally Supports Zebra Mussels	No pertinent water quality standards
Fe	**mg/l**	**4**	**0.388**	**0.6795**	**1.13**	**Taste or odor likely**	**100% of readings violate water quality standards**
Mn	**mg/l**	**4**	**0.171**	**0.27675**	**0.497**	**May have some taste/odor**	**100% of readings violate class 'A' water quality standards**
Mg	mg/l	4	2.39	2.81	3.42		No readings violate water quality standards
K	mg/l	4	0.793	1.072	1.61		No pertinent water quality standards
Na	mg/l	4	11.3	13.68	18.1		No readings violate water quality standards
Cl	mg/l	4	15.2	19.1	27.4	Moderate road salt runoff	No readings violate water quality standards
SO4	mg/l	4	2.6	3.5	4.4		No readings violate water quality standards
Si	mg/l	4	1.52	7.4175	11.4		No pertinent water quality standards

Lake Perception

	UNITS	N	MIN	AVG	MAX	Scientific Classification	Regulatory Comments
Water Clarity Assessment	1-5, 1 best	4	3	3.75	4	High Algae Levels	No pertinent water quality standards
Weed Assessment	1-5, 1 best	4	1	1.75	2	Plants Visible Below Surface	No pertinent water quality standards
Recreational Assessment	1-5, 1 best	4	2	3.25	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
Bottom Samples = grab sample collected from a depth of approximately 1 meter from the lake bottom
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 for class A waters
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

Si = Dissolved silica, mg/l
Detection limit = 0.01 mg/l; no NYS standard or guidance value

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