

## MEMORANDUM

To: The Lake Hopatcong Commission  
 From: M.S. Lambert, Princeton Hydro  
 cc: F.S. Lubnow, Ph.D., Princeton Hydro, LLC  
 Date: 16 July 2008  
 Subject: **Mid-year 2008 water quality monitoring for Lake Hopatcong**  
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This memorandum is a concise summary of the water quality conditions of Lake Hopatcong during the 20 May 2008 and 23 June 2008 monitoring events. It should be noted that discrete water samples were collected on 23 June 2008; however, the *in-situ* meter malfunctioned, and thus *in-situ* data were collected on a return trip to the lake on 1 July 2008. A more comprehensive analysis of the 2008 water quality database will be conducted in the year-end report, after the September sampling event and all of the laboratory results are received.

For the Lake Hopatcong monitoring program, a variety of physical, chemical, and biological data were collected from 11 sampling stations throughout the lake:

<u>Station</u>	<u>Location</u>
1	Woodport Bay
2	Mid-Lake
3	Crescent Cove/River Styx
4	Point Pleasant/King Cove
5	Outlet
6	Henderson Cove
7	Inlet from Lake Shawnee
8*	Great Cove
9*	Byram Cove
10	Northern Woodport Bay
11	Jefferson Canals

\* *In-situ* data only

A calibrated Eureka Amphibian with Manta multi-probe or similar instrument was used to collect *in-situ* data from all 11 stations and included dissolved oxygen (DO), pH, conductivity, and temperature. The *in-situ* data were collected at 0.5 to 1.0 meter intervals from surface to bottom. In addition, sub-surface discrete water samples were collected and analyzed for ammonia-N, nitrate-N, total phosphorus (TP), total suspended solids (TSS), and chlorophyll *a*.

Vertical net tows were conducted for phytoplankton (free-floating algae) and zooplankton (micro-animals, some of which feed on phytoplankton) at the mid-lake sampling station.

The table below provides data on water clarity, measured with a Secchi disk, for Lake Hopatcong during the May and June sampling events. Typically, a lake is perceived by a layperson as being “dirty” or “scummy” when the Secchi depth is less than 1.0 meter (3.3 feet). With few exceptions, Secchi depths observed during the 2008 monitoring events were slightly lower than those observed in 2007. However, all of the Secchi depths were greater than 1.0 meter (3.3 feet), except for ST-3 during the 1 July 2008 event.

Station	May Secchi depth (meters)	July Secchi depth (meters)
1	1.4	1.5
2	1.9	2.1
3	1.2	0.7
4	1.2	1.7
5	1.2	1.4
6	2.2	1.5
7	1.2	1.2
8	1.7	2.2
9	1.9	2.1
10	1.3	1.4
11	1.0	1.2

Temperature changes greater than 1°C over 1 meter (3.3 feet) through the water column indicate that the lake is thermally stratified, which has a profound impact on the physical, chemical, and biological components of a lake ecosystem. Based on the collected *in-situ* data, ST-2 was thermally stratified between 9 and 11 meters below the surface in May and was strongly thermally stratified between 4 and 10 meters during the July event. Furthermore, there was thermal stratification at ST-6 between 1 and 2 meters as well as at ST-9 between 4 and 7 meters.

Overall, Lake Hopatcong was oxygenated from surface to bottom during the May and July monitoring events. At ST-3, DO levels were between 10.15 and 10.23 mg/L in May. However, DO levels were less than 5 mg/L at ST-2 at depths greater than or equal to 13 meters in May and at depths greater than or equal to 6 meters in July. During the July event, ST-9 had DO levels less than 5 mg/L (3.57 to 0.57 mg/L). It should be noted that anoxic conditions (DO <1.0 mg/L) were observed in July at ST-2 and ST-9. The formation of anoxic zones can lead to habitat loss for most species especially in deep water habitat. Anoxic zones reduce viable aquatic habitat because DO concentrations are too low to support respiration.

During the 20 May 2008 monitoring event, surface water pH ranged from 7.02 to 8.65, which was slightly lower than surface water pH observed the previous year (7.65 to 9.09). The pH of the surface waters of Lake Hopatcong varied from 7 to 9.76 during the 1 July 2008 event. The pH levels taken on 1 July 2008 were slightly higher than pH values during the 19 June 2007 monitoring event (6.89 to 8.79). The highest pH values to date were observed at ST-3 in May; this site also had elevated DO concentrations at this time, which signifies high rates of algal and

aquatic plant productivity. It should be noted that the optimum range for pH for most aquatic organisms is between 6.0 and 8.5.

Conductivity is a measure of the capacity of water to carry an electrical charge, based on the amount of dissolved ions (i.e. nutrients and salts) in the water. A waterbody with an extremely low level of productivity will tend to have a conductivity less than 0.1 mmhos / cm, while a highly productive waterbody can have conductivity values greater than 0.5 mmhos / cm. In May conductivity ranged between 0.16 - 0.417 mmhos / cm, while in July they ranged between 0.256 - 0.426 mmhos / cm. At ST-3, where high pH values and DO concentrations were observed in May 2008, the conductivity was 0.417 mmhos / cm. Thus, a high level of dissolved substances was associated with the algal / aquatic plant blooms at ST-3.

Most natural lakes and ponds tend to have surface-water nitrate-N concentrations that vary between < 0.03 and 5.0 mg/L, depending on the time of year. Nitrate concentration ranged from <0.02 to 0.14 mg/L during the May 2008 event and from <0.02 to 0.07 mg/L during the June event.

During the 20 May sampling event, total phosphorus (TP) concentrations varied from 0.02 to 0.05 mg/L (average 0.03 mg/L). Whereas, TP concentrations in Lake Hopatcong during the 24 May 2007 event varied from below 0.02 to 0.03 mg/L (average 0.03 mg/L). The highest TP concentration to date was observed at ST-3 in May 2008; furthermore, ST-3 had one of the highest TP concentrations (0.04 mg/L) in June. TP concentrations ranged from 0.01 to 0.04 mg/L with an average TP of 0.02 mg/L during the 23 June 2008 event. During the June 2007 event, TP concentrations ranged from 0.02 to 0.04 mg/L with an average of 0.02 mg/L. For most temperate waterbodies, TP concentrations greater than 0.03 mg/L can stimulate an excessive amount of algal growth. Based on our in-house experience, large and frequent algal blooms typically occur once TP concentrations exceed 0.06 mg/L. In addition to TP concentrations, pH and DO concentrations support the idea that productivity was high at ST-3 in May 2008.

The targeted average in-lake TP concentration was 0.03 mg/L as stated in the TMDL Restoration Plan for Lake Hopatcong. Thus, all of the in-lake and watershed-based projects that are and will be implemented at Lake Hopatcong are designed to attain this targeted in-lake TP concentration. Approximately 55% and 64% of the stations had TP concentrations at or below 0.03 mg/L during the May and June 2008 monitoring events, respectively. It should be noted that during May and June 2007 monitoring events all TP concentrations were above 0.03 mg/L.

TSS is essentially a measurement of the amount of particulate matter or “dirt” in the water. For most lakes and ponds, TSS concentrations under baseline (non-storm event) conditions are typically less than 25 mg/L. During the May and June events, TSS concentrations were below 3 mg/L at all stations except the deep station at ST-2. TSS concentrations were 3 and 5 mg/L at the deep ST-2 station in May and June, respectively.

Measuring the amount of chlorophyll *a* is an excellent means of measuring algal biomass. Based on our in-house database of Mid-Atlantic waterbodies, when chlorophyll *a* concentrations exceed 30 mg/m<sup>3</sup>, the general perception by the layperson is that the water is “scummy” or “dirty” relative to recreational use. The average chlorophyll *a* concentrations were 11.6 mg/m<sup>3</sup>

and 13 mg/m<sup>3</sup> in May and July, respectively. The highest concentration in May was 19.6 mg/m<sup>3</sup> at ST-5 and in July was 26.8 mg/m<sup>3</sup> ST-3.

The blue-green alga *Coelosphaerium* and the diatom *Fragilaria* were common in Lake Hopatcong during the May 2008 sampling event. Although blooms of *Fragilaria* can give the water a brown or turbid appearance, they are generally considered good algae since they do not produce nuisance surface scums like blue-green algae. Whereas, many blue-green algae are considered undesirable or nuisance species since they produce nuisance blooms and surface scums and are a low-quality source of food for zooplankton. In addition, some blue-green algae produce cyanotoxins. There was a higher diversity of phytoplankton during the 23 June 2008 event relative to May 2008; the most commonly observed phytoplankton included green algae, blue-green algae, diatoms, and dinoflagellates.

There was a moderate diversity of zooplankton during the 20 May 2008 sampling event, with the dominant genera being the small-bodied cladoceran *Bosmina*. The herbivore cladoceran *Daphnia* was observed in small numbers. There was a higher diversity during the 23 June 2008 sampling event, where *Bosmina* and *Cyclops* were the dominant genera. Three herbivores, the cladocerans *Ceriodaphnia* and *Daphnia* and the copepod *Diaptomus*, were also identified in Lake Hopatcong at this time. However, as has been documented over the last 10-15 years, the herbivorous community of zooplankton has never been large in Lake Hopatcong. These conditions are at least partially caused by a large number of zooplankton-eating fishes.

During the May 2008 monitoring event, a few weeds were observed at ST-5 and fragments of Eurasian watermilfoil (EWM) were observed at ST-3. In the Canals near ST-11 EWM and curly leaf pondweed were observed. Based on field observations, the other stations did not have notable submerged aquatic vegetation. It should be noted that during the May 2008 monitoring event, there were rain storms that made sub-surface field observations difficult.

EWM and broad-leaf pondweed fragments were observed in ST-4 and ST-5 during the June event. There was a minimal amount of submerged aquatic vegetation observed at ST-1, 2, 3, 6, 7, 8, and 9. White water lily and spatterdock were observed west of the bridge at ST-7. Similarly, ST-11 had white water lily, spatterdock and watershield along the shoreline. Eel grass and EWM were also scattered around ST-11. Harvesting occurred in the Ingram Cove area between the end of June and beginning of July 2008. It should be noted that harvesting near ST-3 will take place during the week on 14 July 2008.

Based on the current 2008 water quality data, the water quality conditions of Lake Hopatcong were generally consistent with those of a slightly eutrophic ecosystem. Similarly to previous years, ST-3 had the worse conditions in regards to water quality. However, overall water quality conditions were acceptable for a recreational waterbody (i.e. Secchi depths greater than 1.0 meter; chlorophyll a concentrations less than 30 mg/m<sup>3</sup>, etc).

As always, if you have any questions or comments, please feel free to contact Princeton Hydro at 610-524-4220 or by e-mail (flubnow@princetonhydro.com). Thank you for your time.