# MEMORANDUM

To: The Lake Hopatcong Commission,
cc: Ms. Donna Macalle-Holly, Administrator, Lake Hopatcong Commission
Lake Hopatcong Commission
T. Conlow, Princeton Hydro, LLC
From: Fred S. Lubnow, Ph.D., Princeton Hydro, LLC
Date: 20 August 2007
Subject: **May, June and July 2007 water quality sampling for Lake Hopatcong and observations on the lake's community of aquatic macrophytes**

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This memorandum is a concise summary of the water quality conditions of Lake Hopatcong during the 24 May 2007, the 19 June 2007, and the 24 July 2007 monitoring events. A more comprehensive analysis of the 2007 water quality database will be conducted in the season-end report, after the September sampling event.

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

| Station | Location |
|---|---|
| 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 temperature, dissolved oxygen, pH 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 at 9 of the 11 stations 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, June and July sampling events. Water clarity was acceptable throughout all eleven sampling stations, with Secchi depths consistently greater than 1.0 meter. 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).

One observation of note was that the May 2007 Secchi depths were consistently greater than the May 2006 Secchi depths throughout Lake Hopatcong, with the exception of Station 5. This meant more light was penetrating farther into the water column in 2007, stimulating more plant growth. This, in addition to the unusually mild conditions experienced during the first half of the winter with little ice coverage and snow pack, allowed the submerged aquatic vegetation to begin growing particularly early this year.

| Station | May Secchi depth (meters) | June Secchi depth (meters) | July Secchi depth (meters) |
|---|---|---|---|
| 1 | 2.0 | 1.0 | 1.4 |
| 2 | 2.5 | 2.0 | 2.4 |
| 3 | 2.0 | 1.5 | 1.0 |
| 4 | 2.5 | 1.3 | 1.5 |
| 5 | 1.1 | 2.0 | 1.5 |
| 6 | 2.4 | 2.3 | 2.5 |
| 7 | 2.1 | 1.8 | 1.5 |
| 8 | 2.5 | 1.5 | 2.4 |
| 9 | 2.2 | 2.0 | 2.3 |
| 10 | 1.6 | 1.3 | 1.0 |
| 11 | 1.0 | 0.8 | 1.0 |

Based on the collected *in-situ* data, Lake Hopatcong was strongly thermally stratified between 6 and 7 meters below the surface, and was oxygenated from surface to bottom during the May and June 2007 monitoring event. In addition, the pH of the surface waters of Lake Hopatcong varied from 7.65 to 9.09 during the 24 May 2007 sampling event, which was lower than May 2006. During the 19 June 2007 monitoring event pH values in the surface waters ranged from 6.89 to 8.79.

By 24 July 2007 the lake was strongly stratified and well oxygenated (dissolved oxygen concentrations > 5 mg/L) from 6 meters (19.7 ft) to the surface. This same section of the

water column was suitable brown trout habitat (temperature < 20°C and dissolved oxygen > 5 mg/L). At depths greater than 7 meters (23 ft), the lake was anoxic (< 1 mg/L).

During the 24 May 2007 sampling event, total phosphorus (TP) concentrations varied from below 0.02 to 0.03 mg/L, with a mean of 0.03 mg/L. In contrast, TP concentrations in Lake Hopatcong during the 15 May 2006 sampling event varied from 0.03 to 0.08 mg/L, with a mean of 0.04 mg/L. TP concentrations ranged from 0.02 to 0.04 mg/L with an average of 0.02 mg/L during the 19 June 2007 monitoring event. The May and June 2007 TP concentrations were lower than the respective May and June TP concentrations in 2006.

The targeted average in-lake TP concentration is 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. To date, Princeton Hydro has not yet received the TP results of the July 2007 sampling event. All of the 2007 water quality monitoring data will be summarized and analyzed in the year-end report.

The chrysophyte *Dinobryon* and the diatom *Fragilaria* were the dominant algae in Lake Hopatcong during the May 2007 sampling event; these algae typically dominate the plankton of temperate waterbodies during the spring season. While blooms of these algae can give the water a brown or turbid appearance, they are generally considered good since they do not produce nuisance surface scums like blue-green algae. There was no dominant alga in Lake Hopatcong during the 19 June 2007 sampling event, and there was a high diversity of algae including greens, blue-greens, diatoms, and chrysophytes. The high diversity of algae was maintained during the 24 July 2007 sampling event with the dominant algae being *Dinobryon* and the blue-green alga *Anabaena*.

There was a moderate diversity of zooplankton during the 24 May 2007 sampling event, with the dominant genera being the rotifer *Asplanchna* and the small-bodied cladoceran *Bosmina*, with no herbivores. There was higher diversity during the 19 June 2007 sampling event with *Bosmina* being the dominant genus. One herbivore, the cladoceran *Ceriodaphnia*, was also identified in Lake Hopatcong at this time. There was a moderate diversity of zooplankton identified during the 24 July sampling event with no dominant genus, but *Ceriodaphnia* was present.

In mid-May 2007, the distribution and abundance of the submerged aquatic vegetation was moderate in Lake Hopatcong. Curly-leaf pondweed, *Potamogeton crispus*, was present only in Crescent and Jefferson Coves during the May event. Weed harvesting took place prior to the 19 June 2007 monitoring event, but it was evident that the abundance of weeds was increasing. The macrophytes (plants and filamentous algae) identified during the May and June 2007 sampling events included Eurasian watermilfoil, tapegrass, coontail, various species of pondweeds, and the benthic filamentous algae *Lyngbya*. The macrophytes observed during the July 2007 event (weed harvesting a few weeks prior to the sampling event) included the aforementioned species as well as lilies (yellow and white), watershield, bladderwort, and bushy naiad. It should be noted that

during the 24 July 2007 sampling event little to no macrophytes were identified in the southern end of the lake (Stations #4 and #5 and Ingram Cove). These conditions were obviously a result of the weed harvesting activities conducted in late June and early July. Additionally, Ingram Cove was treated earlier in the growing season with the systemic herbicide Sonar$^{R}$.

Mechanical weed harvesting was initiated on 29 May 2007. From 29 May to 11 July 2007 approximately 672 tons (1,344,000 pounds) of aquatic plants were removed from the lake. Using the data that were collected during last year's phosphorus / aquatic plant study, the amount of phosphorus removed from the lake as a result of harvesting activities was calculated. Thus, from 29 May to 11 July 2007 it was estimated that approximately 240 lbs (109 kg) of TP was removed from the lake due to weed harvesting activities. This accounts for 3.3% of the annual TP load targeted for removal under the established TMDL.

Finally, as part of the 24 July 2007 sampling event, a series of aquatic plant samples were collected throughout Lake Hopatcong and then composited into one sample. This plant material was then analyzed for a number of heavy metals, which included silver, aluminum, arsenic, barium, cadmium, chromium, lead selenium and mercury. This analysis was conducted in order to assess the potential for high concentrations of metals within the plant biomass.

Seven of the nine tested metals were below their respective analytical detection limits. The two that had concentrations above their respective detection limits were barium (22.7 mg/kg) and aluminum (90.1 mg/kg). Based on NJDEP's Residential Direct Contact Soil Cleanup Criteria (May 1999) barium concentrations should be below 700 mg/kg. Thus, the barium concentration in the Lake Hopatcong plant biomass sample was well below this Cleanup Criteria. In contrast, aluminum does not have an identified Residential Direct Contact Soil Cleanup Criteria; it is the second most abundant element in the earth's crust with the first being iron. However, measured concentrations of aluminum did not appear to be excessive in the plant biomass sample. Thus, based on the results of the laboratory analysis and the existing State criteria, the aquatic plants of Lake Hopatcong, at least within the composited plant sample, do not appear to contain elevated concentrations of the nine tested metals.

As always, if you have any questions or comments, please feel free to contact either me at our Exton office at 610-524-4220 or my cell phone (610-310-5287). Thank you for your time.