Scientists, Engineers & Environmental Planners Designing Innovative Solutions for Water, Wetland and Soil Resource Management

MEMORANDUM

To: The Lake Hopatcong Commission
From: F.S. Lubnow, Ph.D., Princeton Hydro, LLC
Date: 10 August 2011
Subject: **Mid-year 2011 water quality monitoring for Lake Hopatcong**
# of Pages: four

This memorandum is a concise summary of the water quality conditions of Lake Hopatcong during the 26 May, 21 June and 2 July 2011 monitoring events. It should be noted that discrete water samples were collected during each sampling event but only the May and June data were available at the time this memo was written. A more comprehensive analysis of the 2011 water quality database will be conducted in the year-end report, after the September sampling event is completed and all of the laboratory results have been received.

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

It should be noted that all field protocol and laboratory methodology have been described in detail and have been accepted by NJDEP through an approved QAPP. Also, Princeton Hydro is State-certified for the collection of *in-situ* data and discrete samples (State ID # 10006).

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 (Station #2).

The table below provides data on water clarity, as measured with a Secchi disk, for Lake Hopatcong during the May through July 2011 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). Please note that a "b" after a Secchi value indicates that the disk reached the bottom. It should be noted that all Secchi depths were equal to or greater than the 1.0 meter threshold during all three in-lake monitoring events. This is in spite of fact that the spring was extremely wet with high early to mid-summer temperatures. In general Secchi depths in May through July 2011 were generally better than those measured in 2010 and 2009.

Station	May 2011 Secchi depth (meters)	June 2011 Secchi depth (meters)	July 2011 Secchi depth (meters)
1	1.8	1.6	1.0
2	2.5	2.1	2.7
3	1.5	1.8	1.1
4	2.5	1.4	1.7
5	2.6	1.5	1.7
6	2.0	2.4	1.7
7	1.8b	1.0	1.7b
8	2.5	2.5	2.5
9	2.0	2.2	2.2
10	1.7b	1.2	1.0
11	1.1b	0.8	1.0b

b stands for "to bottom of lake"

Temperature changes greater than 1^{o}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, the deep, mid-section of the lake (Station #2) was thermally stratified during the May through July sampling events.

Overall, Lake Hopatcong was well oxygenated (DO > 5 mg/L) from surface to bottom during the May 2011 monitoring event and oxygenated (DO > 2 mg/L) during the June and July 2011 monitoring events. A similar distribution of DO through the water column of Lake Hopatcong was observed during the 2010 monitoring year.

Through the May to July monitoring events, pH values typically varied from the mid 7.0's to the mid 8.0's. Since the optimum range for pH for most aquatic organisms is between 6.0 and 8.5, the water quality of Lake Hopatcong was generally acceptable relative to pH. There were some rare exceptions; for example, the surface waters at Station #3 had pH values greater than 9.0, which is indicative of excessive amount of photosynthesis.

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. The conductivity through most of Lake Hopatcong in May – July 2011 typically varied from the upper 0.2's to the mid-0.3's with one notable exception. The conductivity in Station #3 was consistently higher relative to the other in-lake sampling stations. For example, in May 2011 conductivity in Station #3 varied between 0.436 and 0.722 mmhos / cm, while June and July conductivity values were between 0.549 and 0.0708, and 0.533 and 0.601 mmhos / cm, respectively. These values indicate that Station #3 tends to have a higher amount of dissolved substances in the water column relative to other sections of the lake.

During the 26 May 2011 sampling event, the total phosphorus (TP) concentration in 8 of the 9 stations was 0.02 mg/L. The exception to this was Station #2, where the TP concentration was 0.03 mg/L. During the 21 June 2011 sampling event TP concentrations varied from 0.01 to 0.04 mg/L with a mean of 0.03 mg/L. The highest June TP and NO_3-N concentrations were measured in the Canal sampling stations (#7 and #11).

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. During the May 2011 sampling event, the surface water TP concentrations were at or below 0.03 mg/L for all collected samples.

In contrast to May 2011, during the June 2011 event, 2 of the 9 collected samples (22%) were above the targeted in-lake TP threshold of 0.03 mg/L. These two slightly elevated TP concentrations, both at 0.04 mg/L, were measured in the two Canal sampling stations. Slightly elevated NO3-N concentrations were also measured in the Canal during the June 2011 sampling event. It should be noted that the Canal stations are located in the Township of Jefferson section of the watershed; the Township is the only municipality within the Lake Hopatcong watershed that is not sewered. Thus, more than likely these elevated nutrient concentrations in the Canals are attributed to leachate moving from the septic system leachfields into the receiving waterway.

TSS is essentially a measurement of the amount of particulate matter or "dirt" in the water. For most lakes and ponds, TSS concentrations during baseline (non-storm event) conditions are typically less than 25 mg/L. Thus, TSS concentrations greater than 25 mg/L are typically perceived by the layperson as being "dirty" or "muddy". TSS concentrations during the May 2011 sampling event were low being at or less than 2 mg/L. June 2011 TSS concentrations were also relatively low varying between < 2 and 4 mg/L.

Measuring the amount of chlorophyll *a* in 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^3, the general perception by the layperson is that the water is "scummy" or "dirty" relative to recreational use. The lake-wide mean chlorophyll *a* concentrations in May 2012 varied between 2.3 and 8.6 mg/m^3, while concentrations in June 2011 varied between 6.0 and 29.4 mg/m^3. While none of the chlorophyll *a* concentrations were greater than the 30 mg/m^3, during the June 2011 sampling event the two Canal stations (#7 and #11) had concentrations greater than 20 mg/m^3 with the Station #11 value near 30 mg/m^3.

In May 2011 the dominant alga was the "brown" alga (a diatom) *Tabellaria*. Several other diatoms, the chrysophyte *Dinobryon*, the blue-green algae *Oscillatoria* and *Anabaena*, and a number of green algae were also identified in the lake in May. The dominant zooplankton were the small-bodied cladoceran *Bosmina* and the predatory rotifer *Asplanchna* in May 2010.

In June 2011 the dominant algae were the two blue-green algae *Anabaena* and *Aphanizomenon*; other algae included the dinoflagellate *Ceratium* and a number of green algae. The dominant zooplankton were the rotifer *Conochilus* and juvenile copepods (called nauplii).

Near-shore, Non-Point Source (NPS) Monitoring Stations

In addition to the baseline in-lake monitoring stations, there are an additional five in-lake stations to monitor near-shore conditions adjacent to watershed sites where stormwater BMPs have been or will be installed. These sites include:

1. The southern end of Crescent Cove in the Borough of Hopatcong (NPS-1).
2. Along the eastern shoreline of the lake, in the Township of Jefferson, just south of Brady's Bridge (NPS-2).
3. Ashley Cove in the Township of Jefferson (NPS-3).
4. King Cove in the Township of Roxbury (NPS-4).
5. Southern end of the public beach at the Hopatcong State Park (NPS-5).

Details on these near-shore sampling stations will be provided in the year-end sampling report. However, it should be cited that both TP and TSS concentrations at all five NPS sampling stations were relatively low during the May and June 2011 sampling event. Again, more details on these near-shore sampling stations will be provided in the year-end report.

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.