LAKE HOPATCONG
WATER QUALITY MONITORING
ANNUAL REPORT 2012

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1.0 INTRODUCTION

Princeton Hydro, LLC conducted general water quality monitoring of Lake Hopatcong during the 2012 growing season (May through September). This monitoring program represents a continuation of the long-term monitoring program of Lake Hopatcong. However, it should be noted that the 2010, 2011 and 2012 water quality monitoring programs have been funded through the NJDEP, SFY10, Non-Point Source (319(h) of the Clean Water Act) grant program (Project Grant RP10-087)

The current water quality monitoring program is a modified version of the program that was originally initiated in the Phase I Diagnostic / Feasibility Study of Lake Hopatcong (PAS, 1983) and continued through the Phase II Implementation Project. Both the Phase I and Phase II projects were funded by the US EPA Clean Lakes (314) Program. The modified monitoring program also continued through the development, revision and approval of the TMDL-based Restoration Plan, as well as through the installation of a series of watershed projects funded through a NJDEP 319 grants and a US EPA Targeted Watershed grant.

The current water quality monitoring program is valuable in terms of continuing to assess the overall “health” of the lake on a year to year basis, identifying long-term trends or changes in water quality, and quantifying and objectively assessing the success and potential impacts of restoration efforts. In addition, the in-lake water quality monitoring program will be an important component of evaluating the long-term success of the implementation of the phosphorus TMDL-based Restoration Plan, which was approved by NJDEP in April of 2006.

2.0 MATERIALS AND METHODS

In-lake water quality monitoring was conducted at the following eleven (11) locations in Lake Hopatcong (represented as red circles in Figure 1, Appendix A) during the study period:

Station Number	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* monitoring only

The 2012 sampling dates were 23 May, 19 June, 24 July, 27 August and 25 September. A Eureka Amphibian PDA with Manta multi-probe unit was used to monitor the *in-situ* parameters: dissolved oxygen (DO), temperature, pH, and specific conductance during each sampling event. Data were recorded at 1.0 m increments starting at 0.25 m below the water's surface and continued to within 0.5-1.0 m of the lake sediments at each station during each sampling date. In addition, water clarity was measured at each sampling station with a Secchi disk.

Discrete water quality samples were collected with a Van Dorn sampling device at 0.5 m below the lake surface and 0.5 m above the sediments at the mid-lake sampling site (Station #2). Discrete samples were collected from a mid-depth position at the remaining six (6) original sampling stations (Stations #1, 3, 4, 5, 6 and 7) and additionally at the Northern Woodport Bay and Jefferson Canals sites (Stations #10 and #11, respectively) on each date. Discrete water samples were appropriately preserved, stored on ice, and transported to a State-certified laboratory for the analysis of the following parameters:

- total suspended solids
- total phosphorus-P
- nitrate-N
- ammonia-N

- chlorophyll *a*

All laboratory analyses were performed in accordance with *Standard Methods for the Examination of Water and Wastewater*, *18th Edition* (American Public Health Association, 1992). Monitoring at the Great Cove (Station #8) and Byram Cove (Station #9) sampling stations consisted of collecting *in-situ* and Secchi disk data; no discrete water samples were collected from these two stations for laboratory analyses. It should be noted that prior to 2005, Station #10 had been monitored for *in-situ* observations only. However, due to observations made at Station #10 by the Lake Hopatcong Commission operations staff, it was decided that this sampling station should be added to the discrete sampling list.

During each sampling event, vertical plankton tows were also conducted at the deep sampling station (Station #2). A 50-µm mesh plankton net was used to sample the phytoplankton, while a 150-µm mesh plankton net was used to sample the zooplankton. The vertical tows were deployed starting immediately above the anoxic zone (DO concentrations < 1 mg/L) and conducted through the water column to the surface.

Additional Water Quality Data Collected in 2012

In addition to the standard, long-term, in-lake monitoring program, supplemental in-lake data were collected during the 2012 monitoring program. From 2006 to 2012 three, near shore, in-lake sampling sites were established and monitored. These additional in-lake sampling sites were located immediately adjacent to drainage areas where a structural BMP was being installed as part of an existing 319(h) grant (SFY05; Grant RP05-080). The three near-shore, in-lake sampling stations included:

1. The southern end of Crescent Cove in the Borough of Hopatcong (NPS-1).
2. Ingram Cove, located in the Borough of Hopatcong (removed from monitoring program).
3. Along the eastern shoreline of the lake, in the Township of Jefferson, just south of Brady's Bridge (NPS-2).

Through the course of implementing the SFY05 319(h) grant, it was determined that no BMP would be installed in the Ingram Cove drainage basin; the Ingram Cove project was dropped from the grant due to site specific limitations associated with existing utilities. Subsequently, the proposed Ingram Cove project was moved to the Crescent Cove drainage area. However, monitoring of the Ingram Cove sampling station continued through 2008 and was discontinued from 2009 through the 2012 monitoring programs.

For the remaining two supplemental in-lake sampling stations, monitoring occurred during the May through September 2012 in-lake monitoring events. Monitoring included collecting *in-situ* data at 0.5 – 1.0 meters from surface to bottom for temperature, dissolved oxygen, pH and specific conductance. Water clarity was also measured at each station with a Secchi disk. Discrete mid-depth water samples were collected and analyzed for TP and TSS. The Crescent Cove station is NPS-1, while the Township of Jefferson station is NPS-2; both are shown in Figure 1 as yellow circles with an "X" inside (Appendix A).

As part of the SFY10 319 grant, some additional watershed-based restoration projects are being implemented to reduce the NPS pollutant load entering Lake Hopatcong, with an emphasis on TP and TSS. Similar to the SFY05 grant, three near-shore sampling sites were located immediately adjacent to drainage areas that were receiving a structural BMP or MTD as part of the SFY10 319(h) grant (Grant RP10-087). These three near-shore, in-lake sampling stations include:

1. In Ashley Cove in the Township of Jefferson (NPS-3).
2. In King Cove in the Township of Roxbury (NPS-4).
3. Southern end of the public beach at the Hopatcong State Park (NPS-5).

Similar to the SFY05 near-shore sampling program (NPS-1 and NPS-2), *in-situ* monitoring and discrete samples were collected for TP and TSS at the three SFY10 near-shore sampling stations during each of the five 2012 monitoring events. However, one addition to the SFY10 sampling program was the collection of an additional set of discrete samples for the analysis of chlorophyll *a*, a photosynthetic pigment all algae possess.

3.0 RESULTS AND DISCUSSION

Thermal Stratification

Thermal stratification is a condition where the warmer surface waters (called the epilimnion) are separated from the cooler bottom waters (called the hypolimnion) through differences in density, and hence, temperature. Thermal stratification separates the bottom waters from the surface waters with a layer of water that displays a sharp decline in temperature with depth (called the metalimnion or thermocline). In turn, this separation of the water layers can have a substantial impact on the ecological processes of a lake (for details see below). Thermal stratification tends to be most pronounced in the deeper portions of a lake. Thus, for convenience, the discussion on thermal stratification in Lake Hopatcong focuses primarily on the deep, mid-lake (Station #2) sampling station.

In-situ measurements during the 2012 growing season were generally consistent with values recorded in previous years' monitoring programs. By the late May event Station #2 exhibited thermal stratification with the epilimnion extending to 4.0 m and the thermocline between 5.0 m and 11.0 m. Thermal stratification was also present at other stations with sufficient depth (i.e. stations 8 and 9). Stratification persisted throughout the remainder of the sampling season with the water column beginning to cool by the September event.

Thermal stratification was not evident at the 319 sampling sites due to the shallow depths of these stations. Water temperatures reached a maximum by the August sampling event and began to cool by the September event.

Thermal stratification can effectively "seal off" the bottom waters from the surface waters and overlying atmosphere, which can result in a depletion of dissolved oxygen (DO) in the bottom waters. With the exception of a few groups of bacteria, all aquatic organisms require measurable amounts of DO (> 1 mg/L) to exist. Thus, once the bottom waters of a lake are depleted of DO, a condition termed anoxia, that portion of the lake is no longer available as viable habitat.

Dissolved Oxygen

Atmospheric oxygen enters water by diffusion from the atmosphere, facilitated by wind and wave action and as a by-product of photosynthesis. Adequate dissolved oxygen (DO) is necessary for acceptable water quality. Oxygen is a necessary element for most forms of life. As dissolved oxygen concentrations fall below 5.0 mg/L, aquatic life is put under stress. DO concentrations that remain below 1.0 – 2.0 mg/L for a few hours can result in large fish kills and loss of other aquatic life. Although some aquatic organisms require a minimum of 1.0 mg/L of DO to survive, the NJDEP State criteria for DO concentrations in surface waters is 5.0 mg/L or greater, for a healthy and diverse aquatic ecosystem.

In addition to a temporary loss of bottom habitat, anoxic conditions (DO < 1 mg/L) can produce chemical reactions that result in a release of dissolved phosphorus from the sediments and into the overlying waters. In turn, a storm event can transport this phosphorus to the upper waters and stimulate additional algal growth. This process is called internal loading. Given the temporary loss of bottom water habitat and the increase in the internal phosphorus load, anoxic conditions are generally considered undesirable in a lake.

DO concentrations at Station #2 during the May event were stratified throughout the water column, ranging from a minimum of 2.13 mg/L at 13.5 m (Z_{max} = 13.7 m) to a maximum of 9.30

mg/L at 1.0 m. DO concentrations were below the 5.0 mg/L threshold from 10.0 m to the lake bottom. DO was generally adequate at the remaining sampling stations with the exception of anoxic conditions near the sediments at Station #5 and slightly depressed DO (4.30 mg/L) near the sediments at Station #8.

DO stratification persisted at Station #2 throughout the sampling season. Hypolimnetic anoxia continued throughout the season with peak anoxia attained by the August sampling event with anoxic conditions recorded from 9.0 m to the lake bottom. DO concentrations began to increase throughout the water column at Station #2 by the September event, which was characterized by anoxic conditions from 12.0 m to the lake bottom.

DO at the other 10 stations was generally adequate with concentrations greater than 5.0 mg/L. An exception to this pattern was depressed DO in the bottom waters of Station #8. Generally speaking, the shallower areas of the lake had adequate DO throughout the water column for the support of aquatic life and did not indicate any problems with DO depletion.

DO concentrations at the NPS monitoring stations were adequate with the majority of DO measurements at or near 100% saturation. There were no instances of DO less then 5.0 mg/L.

Overall, depression of DO was limited to the hypolimnion of Station #2 with periodically low concentrations measured at 7.0 m and greater at Station #8. Thus, the majority of the lake had a sufficient amount of DO to support a diverse and healthy aquatic ecosystem (Appendix B).

pH

The pH is defined as the negative logarithm of the hydrogen ion concentration in water. pH values greater then 7 are termed alkaline while those less then 7 are acidic; a pH value of 7 is neutral. The optimal range of pH for most freshwater organisms is between 6.0 and 9.0.

The pH values at Station #2 during the May sampling event ranged from a minimum of 7.36 at 13.5 m to a maximum of 8.68 at 0.25 m. The pH values were elevated in the photic zone due to algal and macrophyte photosynthesis and depressed with depth due to increased respiration. There was some spatial variation in pH values amongst the varying stations.

The pH values at Station #2 decreased by the June event; values ranged from a minimum of 6.85 at 11.0 m to a maximum of 8.09 at 2.0 m. The pH values at the remaining stations were also lower than those measured during the May event with values generally around the 7-8 range

(Appendix B). Values were slightly elevated at station #10, ranging from 8.42 at 1.5 m to 8.44 at 1.0 m.

The pH values remained relatively stable throughout the remainder of the sampling events and were within a general range of 7 – 8.

The pH values at the NPS stations were generally similar to those measured at the other 11 in-lake stations throughout the monitoring period.

Overall, pH values in Lake Hopatcong during the 2012 monitoring program were within the optimal range for the support of aquatic life and did not exceed the recommended range of 6 – 9 for any extended period of time.

Water Clarity (as measured with a Secchi disk)

Water clarity or transparency was measured at each in-lake monitoring station, during each monitoring event, with a Secchi disk. Based on Princeton Hydro's in-house long-term database of lakes in northern New Jersey, water clarity is considered acceptable for recreational activities when the Secchi depth is equal to or greater than 1.0 m (3.3 ft). Secchi depth fell below the 1.0 m threshold at Stations #1 and #3 during the July event and Stations #1, 3 and #10 during the August event. Secchi depth values were at or greater than 1.0 m at all other stations during the five sampling events.

Secchi depth at Station #2 ranged from a minimum of 1.7 m during the July event to a maximum of 2.5 m during the May and September events with a seasonal mean of 2.24 m.

Secchi depth at the NPS stations was routinely measured to the lake bottom due to the shallowness of these stations. The exception was NPS 1 which had Secchi depths less then 1.0 m during the June, July and August sampling events.

Ammonia-Nitrogen (NH_4-N)

Surface water NH_4-N concentrations above 0.05 mg/L tend to stimulate elevated rates of algal growth. Ammonia concentrations measured during the May event were low in the surface and mid-depth samples, ranging from 0.01 mg/L to 0.03 mg/L. Station #2 deep samples were elevated, due to the anoxic hypolimnion, with a May ammonia-N concentration of 0.42 mg/L. Concentrations in the surface and mid-depth waters remained low during the June event with concentrations ranging from 0.02 mg/L to 0.05 mg/L with a mean concentration of 0.03 mg/L. June Station #2 deep concentrations were lower than those measured in May with a concentration of 0.26 mg/L. Surface to mid-depth concentrations remained low, ranging from non-detectable (ND < 0.01 mg/L) to 0.03 mg/L, during the July event. Deep water ammonia-N at Station #2 began to increase, due to increasing hypolimnetic anoxia, with a concentration of 0.60 mg/L. Concentrations remained low in the surface and mid-waters during the August event, ranging from non-detectable to 0.04 mg/L, while the deep water of Station #2 ammonia-N concentration was 1.70 mg/L. Surface and mid-depth concentrations ranged from 0.03 mg/L to 0.09 mg/L during the September event and the deep water ammonia-N concentration at Station #2 was 1.50 mg/L.

In summary, surface and mid-depth concentrations of ammonia-N were low throughout the 2012 growing season. Hypolimnetic concentrations of ammonia-N were elevated due to conditions resultant from hypolimnetic anoxia.

Nitrate-Nitrogen (NO_3-N)

Nitrate-N concentrations measured in the surface and mid-depth waters during the May sampling event ranged from non-detectable (ND < 0.02 mg/L) to 0.39 mg/L with a mean concentration of 0.06 mg/L. Concentrations were low with the exception of a moderate concentration of 0.39 mg/L at Station #11. Concentrations in the deep waters of Station #2 were 0.06 mg/L. Slightly elevated nitrate-N concentrations at Station #11 were attributed to near-shore septic systems.

Nitrate-N concentrations measured in the surface waters during the June event ranged from non-detectable at Station #2 to a maximum of 0.12 mg/L at Stations #3 and #11. Concentrations in the surface waters, while slightly variable, were within a normal range for the support of a healthy aquatic ecosystem and were of no cause for concern. Concentrations in the deep waters of Station #2 were 0.04 mg/L.

Concentrations for the remainder of the sampling season (July through September) were low with surface water concentrations ranging from non-detectable to 0.08 mg/L. Deep water concentrations at Station #2 ranged from 0.04 mg/L to 0.10 mg/L.

In summary, nitrate-N concentrations were low and exhibited minimal spatial or temporal variability in Lake Hopatcong throughout the 2012 growing season.

Total Phosphorous (TP)

Phosphorus has been identified as the primary limiting nutrient for algae and aquatic plants in Lake Hopatcong. Essentially, a small increase in the phosphorus load will result in a substantial increase in algal and aquatic plant growth. For example, one pound of phosphorus can generate as much as 1,100 lbs of wet algae biomass. This fact emphasizes the continued need to reduce the annual phosphorus load entering Lake Hopatcong, as detailed in the lake's revised TMDL and associated Restoration Plan.

Studies have shown that TP concentrations as low as 0.03 mg/L can stimulate high rates of algal growth resulting in eutrophic or highly productive conditions. Based on Princeton Hydro's in-house database on northern New Jersey lakes, TP concentrations equal to or greater than 0.06 mg/L will typically result in the development of algal blooms / mats that are perceived as a nuisance by the layperson.

The State's Surface Water Quality Standard (SWQS, N.J.A.C. 7:9B – 1.14(c) 5) for TP in the surface waters of a freshwater lake or impoundment is 0.05 mg/L. This established TP concentration is for any freshwater lake or impoundment in New Jersey that does not have an established TMDL. Lake Hopatcong has established a phosphorus TMDL, which was revised and approved by NJDEP in June 2006. Based on its refined phosphorus TMDL, the long-term management goal is to maintain an average, growing season TP concentration of 0.03 mg/L within the surface waters of Lake Hopatcong.

TP concentrations measured in the surface waters during the May sampling event ranged from 0.02 mg/L to 0.05 mg/L with a surface water mean concentration of 0.02 mg/L. The maximum surface water TP concentration of 0.05 mg/L was recorded at Station #11. The deep water TP concentration at Station #2 was 0.10 mg/L. Concentrations were generally low in the surface waters with the exception of a slightly elevated value at Station #11.

TP concentrations in the surface waters were variable during the June event and ranged from 0.01 mg/L to 0.04 mg/L with a mean concentration of 0.03 mg/L. The maximum surface water TP concentration of 0.04 mg/L was recorded at Stations #3, #7 and #11. Deep water TP at Station #2 was 0.02 mg/L.

TP measured during the July event exhibited more spatial variation throughout Lake Hopatcong with concentrations ranging from 0.02 mg/L to 0.06 mg/L in the surface waters. The maximum surface water TP concentration of 0.06 mg/L was measured at Station #3. Two of the nine surface water TP concentrations were greater then the recommended concentration of 0.03 mg/L.

July deep water TP concentrations were markedly higher than those measured during the June event with a concentration of 0.14 mg/L.

Surface water TP ranged from 0.01 mg/L to 0.05 mg/L with a mean surface water TP concentration of 0.03 mg/L during the August event. Four of the nine surface water TP samples equaled or were greater than the recommended threshold concentration of 0.03 mg/L. The deep water TP concentration at Station #2 was 0.35 mg/L. This concentration was more than an order of magnitude greater then the recommended concentration of 0.03 mg/L and was indicative of some internal loading of phosphorus during this sampling event.

TP concentrations remained variable during the September event with surface water concentrations ranging from 0.01 mg/L to 0.05 mg/l with a surface water mean concentration of 0.03 mg/L. Four of the nine surface water TP concentrations were at or above the 0.03 mg/L threshold. Deep water TP concentrations at station #2 remained elevated with a concentration of 0.26 mg/L.

It has been well documented in past reports that Station #3 (River Styx / Crescent Cove) consistently has the highest TP concentrations among the standard eleven monitoring stations in Lake Hopatcong. Since the long-term monitoring of Lake Hoaptcong was initiated in the 1980's, elevated TP concentrations in the River Styx / Crescent Cove section of the lake is a re-occurring condition. For example in 2012, the mean TP concentration at Station #2 (Mid-lake) was 0.02 mg/L, while the Station #3 mean was 0.04 mg/L. It should also be noted that the mean TP concentration at Station #11 (Jefferson Canals) was 0.03 mg/L.

Similar to past monitoring years, higher TP concentrations tend to be found at Station #3. While mean TP concentrations have been declining at Station #3 from 2009 through 2011, the mean concentration slightly increased in 2012 with a value of 0.044 mg/L. Continued monitoring will aid in determining if this slightly increase in 2012 is natural, inter-annual variation or part of a larger trend.

Bottom water TP concentrations at the mid-lake sampling station (Station #2) varied between 0.02 and 0.35 mg/L from May through September of 2012 with a mean concentration of 0.17 mg/L. The elevated TP concentrations in the deep waters were attributed to the anoxic conditions and the lack of mixing with the atmosphere during the summer season.

TP concentrations at the NPS stations were generally acceptable with the exception of elevated concentrations relative to a threshold of 0.03 mg/l at NPS-1. The TP concentrations at NPS-1 ranged from 0.03 mg/L to 0.08 mg/L with a seasonal mean concentration of 0.056 mg/L. TP concentrations at NPS-1 steadily increased from May till August and then declined by the September event to 0.03 mg/L.

As part of the existing SFY05 319 grant, two large Aqua-Filter Manufactured Treatment Devices (MTDs) were installed in the southern end of the Crescent Cove drainage basin to reduce a large portion of the TP and TSS loads that enter the lake from this section of the watershed. The first MTD was installed in November of 2008, while the second was installed in June of 2011. The NPS-1 monitoring station was established in 2006 in order to assess how the implementation of these MTDs, as well as other restoration measures (i.e. sewering part of the drainage area; more wide-spread use of non-phosphorus fertilizers) have impacted this section of the lake.

Thus, the data collected from 2006 to 2008 were prior to the installation of the two large Aqua-Filters, while the data collected in 2009 and 2010 were after the first Aqua-Filter was installed and the data collected in 2011 and 2012 were after the second Aqua-Filter was installed.

As shown in Table 1, before the first Aqua-Filters installed the mean growing season (May – September) TP concentration in Crescent Cove varied between 0.063 to 0.065 mg/L; these mean values are greater than both the State’s Surface Water Quality Standard of 0.05 mg/L for standing waterbodies as well as the targeted TMDL concentration of 0.03 mg/L. However, after the first Aqua-Filter was installed in late 2008, the mean TP concentration declined to 0.045 mg/L (Table 1; 2009 monitoring year). While this value was still greater than the targeted TMDL concentration of 0.03 mg/L, it was below the State’s Surface Water Quality Standard of 0.05 mg/L. In addition, only one of four TP measurements in 2009 was above the State standard.

However, in sharp contrast to the 2009 results, during the 2010 growing season, only one of the five sampling events was below the Sate Standard at NPS-1. The mean TP concentration at NPS-1 in 2010 was 0.068 mg/L slightly above the mean values measured prior to the installation of the Aqua-Filter (2006-08). These conditions were in spite of the fact that 2010 had a relatively dry growing season. More than likely, these elevated TP concentrations indicate that the first Aqua-Filter needs to be maintained. Specifically, the filter pillows need to be replaced and the Aqua-Swirl portion of the structure needs to be cleaned out. At a minimum, the Aqua-Filter should be inspected quarterly and accumulated material in the Aqua-Swirl should be vacuumed out several times a year. This would allow the structure to at least continue to remove accumulated sediments and the phosphorus adsorbed onto such particles. However, to maximize its phosphorus removal capacity, the filter pillows should be replaced as well.

The second Aqua-Filter was operating by the end of June 2011 and the resulting mean growing season TP concentration for NPS-1 was 0.036 mg/L, the lowest mean value of the entire 2006 - 2011 dataset (Table 1). Of the five 2011 sampling events, only one was above the State standard. In addition, three of the five had TP concentration at or below the TP concentration targeted under the TMDL (0.03 mg/L). However, by 2012 TP concentrations were again on the raise with a mean of 0.054 mg/L, slightly above the State threshold (Table 1 and Figure 1). Of the five measurements collected over the 2012 growing season, only two were below the State threshold. Thus, as with the first Aqua-Filter unit, the second one needs to be routinely inspected and cleaned out of particulate material. In addition, to maximize the removal of phosphorus, the filter pillows will need to be replaced sometime next year. Based on this seven year dataset, the installed Aqua-Filters can have a positive impact on water quality by reducing TP and TSS (see below) concentrations. However, as previously stated, to maximize the efficiency of this removal, the units do need to be routinely inspected and cleaned out.

Table 1
The Mean and Range of TP and TSS Concentrations for Crescent Cove From June through September of Each Monitored Year

Monitoring Year	TP mean and range	TSS mean and range
2006 (pre-installation)	0.064 mg/L (0.05 – 0.09 mg/L)	12 mg/L (6 – 15 mg/L)
2007 (pre-installation)	0.063 mg/L (0.05 – 0.08 mg/L)	7 mg/L (3 – 11 mg/L)
2008 (pre-installation)	0.065 mg/L (0.04 – 0.08 mg/L)	18 mg/L (1.5 – 48 mg/L)
2009 (post-installation)	0.045 mg/L (0.03 – 0.06 mg/L)	7 mg/L (1.5 – 8 mg/L)
2010 (post-installation)	0.068 mg/L (0.02 – 0.09 mg/L)	8 mg/L (1 -15 mg/L)
2011 (post-installation)	0.036 mg/L (0.01 – 0.08 mg/L)	5 mg/L (1 – 11 mg/L)
2012 (post-installation)	0.054 mg/L (0.03 – 0.08 mg/L)	6 mg/L (3 – 10 mg/L)

While not discussed in detail, it should be noted that there has been a measurable decline in TSS concentrations once the Aqua-Filters were installed. Prior to their installation (2006 – 2008) TSS concentrations ranged from 1.5 to 48 mg/L, with growing season means ranging from 7 to 18 mg/L. In contrast, after the Aqua-Filters were installed, TSS concentrations ranged from 1 to 15 mg/L, with growing season means ranging from 5 to 8 mg/L (Table 1). Thus, in-lake TSS concentrations were lower in the southern end of Crescent Cove, once the Aqua-Filters were installed.

Figure 1 – TP Concentrations at Crescent Cove

Chlorophyll a

Chlorophyll *a* is a pigment possessed by all algal groups, used in the process of photosynthesis. Its measurement is an excellent means of quantifying algal biomass. In general, an algal bloom is typically perceived as a problem by the layperson when chlorophyll *a* concentrations are equal to or greater than 30.0 µg/L. Based on the findings of the refined TMDL, the existing average seasonal chlorophyll *a* concentration under current conditions is 15 µg/L, while the maximum seasonal value is 26 µg/L. In contrast, the targeted average and maximum chlorophyll *a* concentrations, once Lake Hopatcong is in complete compliance with the TMDL, are predicted to be 8 and 14 µg/L, respectively.

Chlorophyll *a* concentrations during the May event ranged from 1.2 µg/L at Station #3 to 58.2 µg/L at Station #11 with a mean concentration of 10.2 µg/L. Station #11 was characterized by markedly higher chlorophyll *a* concentrations in relation to the other eight stations. If excluded from analysis, the mean concentration for the May event would be 4.2 µg/L and the targeted maximum concentration of 14 µg/L wouldn't be exceeded.

Chlorophyll *a* concentrations increased by the June event with concentrations ranging from 8.3 µg/L at Station #4 to 22.7 µg/L at Station #7 with a mean concentration of 13.1 µg/L. The targeted mean concentration was exceeded and the targeted maximum concentration was exceeded at three of the nine sample sites.

Chlorophyll *a* continued to increase by the July event with concentrations ranging from 4.3 µg/L at Station #7 to 67.7 µg/L at Station #3 with a mean concentration of 21.3 µg/L. The maximum threshold was exceeded by all stations with the exception of Stations #7 and #11. Decreasing chlorophyll *a* was noted lake-wide by the August event. Concentrations ranged from 3.1 µg/L at Station #7 to 37 µg/L at Station #3 with a mean concentration of 15.6 µg/L. The targeted mean was exceeded while the targeted individual maximum concentration was exceeded at five of the nine stations.

Chlorophyll *a* continued to decline by the September event with concentrations ranging from 1.9 µg/L at Station #7 to 33 µg/L at Station #3 with a mean concentration of 10.5 µg/L. The targeted maximum concentration of 14 µg/L was exceeded by one of the nine stations during the September event (Station #3).

Chlorophyll *a* concentrations at the NPS stations were low during the May event (1.9 µg/L – 4.4 µg/L) and increased to maximum values during the July and August events. The targeted maximum of 14 µg/L was exceeded by NPS-4 during the June event and NPS-4 and NPS-5 during the July and August events.

Phytoplankton

Phytoplankton are algae that are freely floating in the open waters of a lake or pond. These algae are vital to supporting a healthy ecosystem, since they are the base of the aquatic food web. However, high densities of phytoplankton can produce nuisance conditions. The majority of nuisance algal blooms in freshwater ecosystems is the result of cyanobacteria, also known as blue-green algae. Some of the more common water quality problems created by blue-green algae include bright green surface scums, taste and odor problems and the generation of cyanotoxins.

Table 1 lists the dominant phytoplankton identified in Lake Hopatcong during each water quality monitoring event in 2012. Algal abundance was moderate on 23 May 20112 with the dominant algae being the diatoms *Tabellaria* and *Fragilaria*. Several dinoflagellates, green algae, and the chrysophyte *Dinobryon* were also identified. Three genera of blue-green algae were identified as well, and included *Coelosphaerium*, *Aphanizomenon* and *Anabaena*.

Algal abundance was moderate during the 19 June 2012 sampling event, with the blue-green alga *Anabaena* being the dominant genus. Several other green algae, diatoms and the dinoflagellate Peridinium were also identified. In addition three other genera of blue-green algae (*Oscillatoria*, *Coelosphaerium* and *Microcystis*) were identified.

Again, algal abundance was moderate during the 24 July 2012 sampling event. The phytoplankton community at this time was very similar to its composition during the June 2012 sampling event; *Anabaena* was again the dominant genus. One difference was the presence of additional diatoms during the July 2012 sampling event.

Abundance was moderate while diversity was low during the August 2012 sampling event with the dominant algae being *Oscillatoria* and the diatom *Tabellaria*. Several other genera were identified including the cryptomonad *Cryptomonas*, the diatom *Asterionella* and *Anabaena*.

Algal abundance and diversity was relatively high in Lake Hopatcong during the September 2012 sampling event. The dominant alga was the diatom *Tabellaria*, while the sub-dominant genera were the diatom *Melosira* and *Anabaena*.

The phytoplankton community at Lake Hopatcong was fairly diverse during most of the 2012 sampling events with the dominant groups typically being diatoms and/or blue-green algae. While blue-green algae, particularly *Anabaena*, were fairly common, large, nuisance surface scums or blooms were not observed at Station #2 (mid-lake).

Zooplankton

Zooplankton are the micro-animals that live in the open waters of a lake or pond. Some large-bodied zooplankton are a source of food for forage and/or young gamefish. In addition, many of these large-bodied zooplankton are also herbivorous (i.e. algae eating) and can function as a natural means of controlling excessive algal biomass. Given the important role zooplankton serve in the aquatic food web of lakes and ponds, samples for these organisms were collected at Station #2 during each monitoring event. The results of these samples are provided in Table 2.

During the 23 May 2012 sampling event, the small-bodied cladoceran *Bosmina*, which feeds primarily on bacteria and detritus, was the dominant genus. Similar to May 2011, no herbivorous (algae-eating) zooplankton were identified in the sample.

While a bloom of *Bosmina* was identified in the June 2012 sample (Table 2), three herbivorous zooplankton (the cladocerans *Daphnia* and *Ceriodaphnia* as well as the copepod *Diaptomus*) were also identified.

By 24 July 2012 zooplankton abundance was moderate and not dominated by one genus. The same three herbivores identified in the June 2012 sample were also identified in the July 2012 sample, as well as *Bosmina*, the carnivorous copepod *Cyclops* and juvenile copepods (called nauplii).

The composition of the zooplankton in the August 2012 sample was very unusual. The only zooplankton contained in the sample were some nauplii. While the plankton nets were inspected after this sampling event, there was no indication of a tear or rip in the net. Thus, it is possible the net was twisted or turned upside down as it came to the surface since these results are particularly unusual.

By 25 September 2012, the composition of the zooplankton sample was more typical for what is found at Lake Hopatcong. Nauplii and a variety of rotifers were the dominant zooplankton at this time; however two herbivores (*Ceriodaphnia* and *Diaptomus*) were present as well as *Cyclops*.

Similar to past monitoring years, herbivorous zooplankton were present in Lake Hopatcong but not in high numbers and none attained large sizes (total length). Such conditions are indicative of a fishery community dominated by a large number of small, zooplankton-feeding fishes (i.e. golden shiners, alewife, young perch), where large-bodied zooplankton cannot exert a high degree of algal control through grazing.

Table 1
Phytoplankton in Lake Hopatcong during the 2012 Growing Season

Sampling Date	Phytoplankton
23 May 2012	Algal abundance was moderate. The dominant algae were the diatoms *Tabellaria*, and *Fragilaria*. Another diatom, *Melosira*, was identified as well as several dinoflagellates, *Peridinium* and *Ceratium*, and the chrysophyte *Dinobryon*. Several green (*Gloeocystis*, *Chlorella*, *Sphaeriocystis*) and blue-green algae (*Coelosphaerium*, *Aphanizomenon Anabaena*) were also present
19 June 2012	Total algal abundance was moderate with the dominant genus being the blue-green alga *Anabaena*. Other identified algae included several green algae (such as *Pediastrum* and *Westella*), diatoms (*Fragilaria*, *Pinnularia*), blue-green algae (*Microcystis*, *Oscillatoria*, *Coelosphaerium*) and the dinoflagellate *Peridinium*.
24 July 2012	Algal abundance was moderate with a community composition similar to what was observed during the 19 June 2012 sampling event. However, a few more diatoms (*Melosira*, *Tabellaria*, *and Asterionella*) and green algae (*Staurastrum*) were identified.
27 August 2012	Abundance was moderate and diversity was low with the dominant algae being the blue-green alga *Oscillatoria* and the diatom *Tabellaria*. Other identified algae included the cryptomonad *Cryptomonas*, the diatom *Asterionella* and the blue-green alga *Anabaena*.
25 September 2012	Abundance and diversity was high; the dominant alga was diatom *Tabellaria*. The diatom *Melosira* and the blue-green alga *Anabaena* were sub-dominant genera. Two additional blue-green were identified, as well as an additional diatom (*Tabellaria*), the dinoflagellate *Ceratium* and several green algae.

Table 2
Zooplankton in Lake Hopatcong during the 2012 Growing Season

Sampling Date	Zooplankton
23 May 2012	Zooplankton numbers were high and the dominant genus was the small-bodied cladoceran *Bosmina*. A carnivorous copepod (*Cyclops*) and juvenile copepods (known as nauplii) were also found in the sample. In addition, several rotifers (*Keratella*, *Asplanchna* and *Polyarthra*) were identified.
19 June 2012	A bloom of the small-bodied cladoceran *Bosmina* was present. In addition, three herbivorous (algae-eating) zooplankton were identified (cladocerans *Daphnia* and *Ceriodaphnia*; copepod *Diaptomus*) as well as several other copepods and the rotifer *Keratella*.
24 July 2012	Zooplankton abundance was moderate and the community was not dominated by one genus. The same three herbivores identified in June 2012 were identified as well the cladoceran *Bosmina*, the copepod *Cyclops* and nauplii.
27 August 2012	The number of zooplankton in this sample was unusually low. In fact, the only zooplankton identified in this sample were juvenile copepods (known as nauplii).
25 September 2012	Zooplankton abundance was moderate with nauplii and the rotifers (*Keratella*, *Brachionus*, *Polyarthra*, *Asplanchna*) being the dominant organisms. In addition, the herbivores *Ceriodaphnia* and *Diaptomus* were identified as well as the carnivorous copepod *Cyclops*.

Recreational Fishery and Potential Brown Trout Habitat

Of the recreational gamefish that reside or are stocked in Lake Hopatcong, trout are the most sensitive in terms of water quality. For their sustained management, all species of trout require DO concentrations of at least 4 mg/L or greater. However, the State's designated water quality criterion to sustain a healthy, aquatic ecosystem is a DO concentration of at least 5 mg/L.

While all trout are designated as coldwater fish, trout species display varying levels of thermal tolerance. Brown trout (*Salmo trutta*) have an optimal summer water temperature range of 18 to 24^{o}C (65 to 75^{o}F) (USEPA, 1994). However, these fish can survive in waters as warm as 26^{o}C (79^{o}F) (Scott and Crossman, 1973), defined here as acceptable habitat. The 2012 temperature and DO data for Lake Hopatcong were examined to identify the presence of optimal and acceptable brown trout habitat. As with previous monitoring reports, this analysis focused primarily on *in-situ* data collected at the mid-lake sampling station (Station #2).

For the sake of this analysis, sections of the lake that had DO concentrations equal to or greater than 5 mg/L and water temperatures less than 24^{o}C were considered optimal habitat for brown trout. In contrast, sections of the lake that had DO concentrations equal to or greater than 5 mg/L and water temperatures between 24 and 26^{o}C were considered carry over habitat for brown trout.

Optimal brown trout habitat was present in the uppermost 9.0 m of the water column during the May 2012 sampling event at Station #2. Optimal habitat decreased slightly by the June 2012 event and consisted of the uppermost 8.0 m of the water column. Habitat continued to shrink by the July 2012 event which was characterized by having carryover habitat in the uppermost 6.0 m of the water column. Carryover habitat area remained consistent through the August 2012 event. Optimal habitat re-emerged in the uppermost 9.0 m of the water column by the September 2012 event due to increased cooling of the water column.

Similar to past monitoring years, the *in-situ* data revealed that varying levels of acceptable brown trout habitat persisted through the entire 2012 growing season in Lake Hopatcong.

Mechanical Weed Harvesting Program

Many of the more shallow sections of Lake Hopatcong are susceptible to the proliferation of nuisance densities of rooted aquatic plants. Given the size of Lake Hopatcong, the composition of its aquatic plant community, and its heavy and diverse recreational use, mechanical weed harvesting is the most cost effective and ecologically sound method of controlling nuisance weed densities. Thus, the weed harvesting program has been in operation at Lake Hopatcong since the mid-1980's with varying levels of success. However, one consistent advantage mechanical weed harvesting has over other management techniques, such as the application of aquatic herbicides, is that phosphorus is removed from the lake along with the weed biomass. In fact, based on a plant biomass study conducted at Lake Hopatcong in 2006 and the plant harvesting records from 2006 to 2008, approximately 6-8% of the total phosphorus load targeted for reduction under the established TMDL was removed through the mechanical weed harvesting program.

In sharp contrast to the 2006 – 2008 harvesting years, only 1.2% of the phosphorus load targeted for reduction under the TMDL was removed through mechanical weed harvesting during the 2009 growing season. This substantial reduction in the amount of plant biomass and phosphorus removed in 2009 was due to severe budgetary cuts that resulted in laying off the Commission's full time Operation Staff and late start up date. In turn, this resulted in only 1.2% of the plant biomass harvested in 2009. However, the 2010 harvesting season resulted in the estimated removal of approximately 6% of the phosphorus load targeted for reduction under the TMDL, similar to the percentages removed in 2006 – 2008.

Unfortunately, the minimal amount of funds available for mechanical weed harvesting resulted in a severe limitation in the amount of harvesting that could be conducted in 2012. However, more weeds, and therefore phosphorus, were removed from the lake in 2012 relative to 2011. This is explained by more harvesting time in 2012 and NJDEP having more experience in managing and coordinating the harvesting program.

Mechanical weed harvesting was conducted at Lake Hopatcong in 2012 from 1st of July to the 6th of September. A total of 1,980 cubic yards of wet plant biomass was removed from the lake in 2012, which resulted in the removal of 42 lbs (19 lbs) of phosphorus. In turn, this accounted for 0.6% of the TP load targeted for removal under the TMDL. This is the second lowest amount of weed biomass and phosphorus removed since the Commission's harvesting program has been in operation (2002 – 2012). If this removed phosphorus was utilized by filamentous and planktonic algae, it would have the potential to generate approximately 46,186 lbs of wet algae biomass.

Inter-annual Analysis of Water Quality Data

Annual mean values of Secchi depth, chlorophyll *a* and total phosphorus concentrations were calculated for the years 1991 through 2012. The annual mean values for Station #2 were graphed, along with the long-term, "running mean" for the lake.

The 2012 mean Secchi depth was 2.2 meters, which was similar to the 2011 mean Secchi depth of 2.3 meters (Figure 2 in Appendix A). This is the third year in a row that the mean Secchi depth has been greater 2.0 meters. In addition, the long-term Secchi depth mean remains slightly above 2 meters.

Unlike Secchi depth, chlorophyll *a* concentrations exhibited a wide range of variability at Lake Hopatcong (Figure 3 in Appendix A). The mean 2012 chlorophyll *a* concentration was 9.1 mg/m^3 in contrast to the mean 2011 value of 11.6 mg/m^3. The 2012 mean chlorophyll *a* concentration was slightly lower than the long-term mean of 9.9 mg/m^3. It should be noted that the 2012 mean was slightly higher than the TMDL's targeted mean endpoint of 8 mg/m^3.

While the 2012 mean TP concentration (0.018 mg/L) at Station #2 was higher relative to the 2011 mean value (0.016 mg/L), it still remained below 0.020 mg/L. The mean TP concentration has been below 0.020 mg/L at Station #2 since 2008 (Figure 4 in Appendix A). In addition, the mean TP concentration at Station #2 has been consistently below the TMDL targeted mean of 0.03 mg/L since 1998.

Water Quality Impairments and Established TMDL Criteria

As identified in N.J.A.C. 7:9B-1.5(g)2 "Except as due to natural condition, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation or otherwise render the waters unsuitable for the designated uses." For Lake Hopatcong, these objectionable conditions specifically include both algal blooms and nuisance densities of aquatic vegetation.

Given the undesirable water quality conditions experienced in select portions of Lake Hopatcong, NJDEP conducted a Total Maximum Daily Load (TMDL) analysis for TP, the primary nutrient limiting algal and plant growth in the lake. This TMDL was revised by Princeton Hydro, who also developed a Restoration Plan for the lake and watershed. The revised TMDL and associated Restoration Plan were approved by NJDEP in 2006 and have been used to obtain grant funding through both NJDEP and US EPA to implement various watershed-based projects to reduce the existing phosphorus loads. Some of these projects were completed in

2008-10 and implementation will continue into 2013. Thus, continuing the long-term monitoring program and augmenting it with near-shore, in-lake and stormwater sampling will provide a means of quantifying the water quality improvements associated with the implementation of these projects.

As described in detail in the TMDL Restoration Plan, a targeted mean TP concentration, as well as mean and maximum chlorophyll *a* ecological endpoints, was established to identify compliance with the TMDL. For the sake of this 2012 analysis, the mid-lake (Station #2) and Crescent Cover / River Styx (Station #3) monitoring stations were reviewed. To provide guidance for this review, the criteria developed under Lake Hopatcong's TMDL are provided below:

TMDL Criteria for Lake Hopatcong

Targeted mean TP concentration	0.03 mg/L
Targeted mean chlorophyll *a* concentration endpoint	8 mg/m^3
Targeted maximum chlorophyll *a* concentration endpoint	14 mg/m^3

As previously mentioned, the mean 2012 chlorophyll *a* concentration for Station #2 was 9.1 mg/m^3 which is above the mean endpoint of 8 mg/m^3. The maximum chlorophyll *a* concentration at Station #2 (12.2 mg/m^3) was below the targeted endpoint of 14 mg/m^3. The mean 2012 TP concentration of 0.018 mg/L was below the targeted mean TP concentration under the TMDL.

The mean chlorophyll *a* concentration at Station #3 (30 mg/m^3) was greater then the threshold concentration of 8 mg/m^3 while the maximum threshold was exceeded during three of the five events. The mean TP concentration of 0.044 mg/L also exceeded the targeted mean of 0.03 mg/L.

4.0 SUMMARY

This report documents the findings of the 2012 Lake Hopatcong water quality monitoring program. This section provides a summary of the 2012 water quality conditions, as well as recommendations on how to preserve the highly valued aquatic resources of Lake Hopatcong.

1. In contrast to 2011 that was a relatively wet and cool year, the summer of 2012 was relatively hot with sporadic storm events. Thus, anoxic conditions (dissolved oxygen concentrations < 1 mg/L) appeared in the bottom waters by late July and were documented during the August and September sampling events as well. All near-shore, shallow NPS sampling stations were well oxygenated from surface to bottom.

2. It has been well documented that phosphorus is the primary limiting nutrient in Lake Hopatcong. That is, a slight increase in phosphorus will result in a substantial increase amount of algal and/or aquatic plant biomass. TP concentrations in the surface waters of Lake Hopatcong typically varied between <0.01 mg/L and 0.04 mg/L, with three instances of the TP concentration being 0.05 mg/L and one instance of the TP concentration being 0.06 mg/L. Similar to past monitoring years, Station #3 (River Styx/Crescent Cove) tended to have the highest TP concentration with a growing season mean of 0.044 mg/L, above the TMDL-based threshold for Lake Hopatcong of 0.03 mg/L.

3. In spite of the elevated concentrations at Station #3, overall TP concentrations were generally low in Lake Hopatcong. For example, the mean 2012 TP concentration at the mid-lake station was 0.018 mg/L. This is slightly higher than the 2011 mean but is still well below the TMDL-based threshold value.

4. Based on the *in-situ* conditions, carry-over brown trout habitat was available throughout the entire 2012 growing season. In contrast, optimal brown trout habitat was present in May and June, was not present in July and August and re-appeared in September 2012. However, carry-over habitat was available through the entire 2012 growing season. Such results are consistent with those measured in previous monitoring years at Lake Hopatcong.

5. Mechanical weed harvesting started on 2 July and ended on 6 September 2012. This year’s program removed approximately 1,980 cubic yards of wet plant biomass. This resulted in removing 42 lbs of TP, accounting for 0.6% of the TP targeted for removal under the TMDL. It should be noted that the amount of TP removed in 2012 was almost twice the corrected amount removed in 2011.

6. Within recent years there has been a general trend of lower TP concentrations (since 2007), lower chlorophyll *a* concentrations (since 2004) and improved water clarity (since 2005). These long-term data were collected from the mid-lake sampling station and indicate that the lake has been trending toward better water quality conditions. However, there are still some locations that require additional attention (River Styx / Crescent Cove; northern end of the lake).

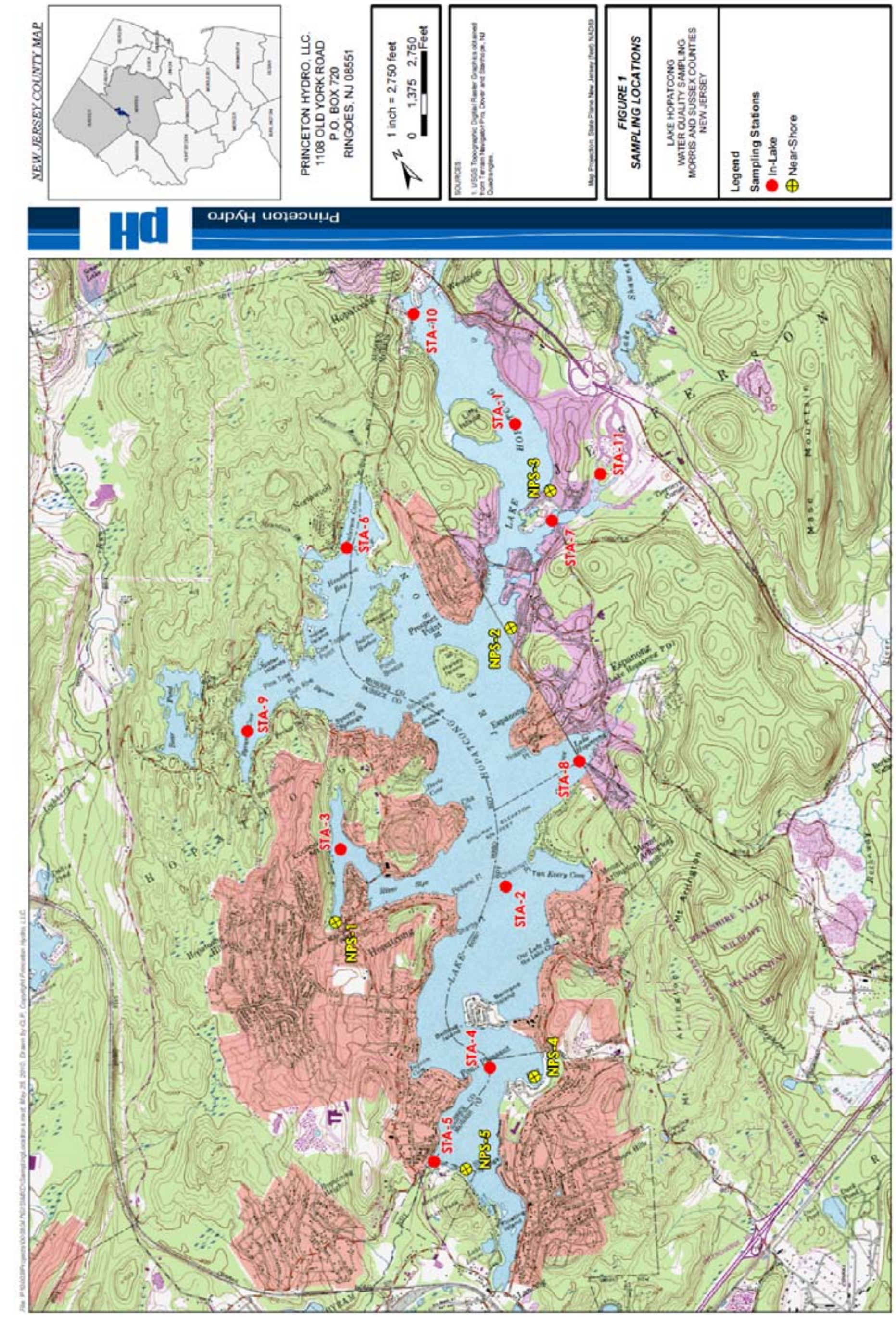
7. An Aqua-Filter, a large Manufactured Treatment Device, was installed in the Crescent Cove drainage basin in November / December 2008. Thus, 2009 was the first year the lake was monitored after this stormwater structure was installed. Overall TP concentrations in the southern end of Crescent Cove were lower in 2009 after the installation of the Aqua-Filter, in spite of it being a wetter year. As shown below only one sampling event displayed a TP concentration greater than the State's TP water quality standard in 2009.

8. In contrast, in 2010 four of the five sampling events at the southern end of Crescent Cove were greater than the State's TP water quality standard. Based on these results, it is more than likely that the first Aqua-Filter unit installed in late 2008 needs to be cleaned out and/or the filter pillows need to be replaced.

9. After the second Aqua-Filter was installed in the end of June 2011, TP concentrations were high in July 2011 but were below State's TP water quality standard in August and October 2011. However, by June 2012, TP concentrations in Crescent Cove were above the State standard and remained so through August 2012. By September 2012, the TP concentration fell below the State standard; however, these data clearly demonstrate that the Aqua-Filters need to be cleaned out and/or have the filter pillows replaced. At a minimum, both structured should have their Aqua-Swirl components cleaned out with a Vac-all truck.

APPENDIX A

FIGURES


NEW JERSEY COUNTY MAP
PRINCETON HYDRO, LLC
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551
1 inch = 2,750 feet
0 1,375 2,750
Feet
FIGURE 1
SAMPLING LOCATIONS
LAKE HOPATCONG
WATER QUALITY SAMPLING
MORRIS AND SUSSEX COUNTIES
NEW JERSEY
Legend
Sampling Stations
In-Lake
Near-Shore
Princeton Hydro
STA-1
STA-2
STA-3
STA-4
STA-5
STA-6
STA-7
STA-8
STA-9
STA-10
STA-11
NPS-1
NPS-2
NPS-3
NPS-4
NPS-5

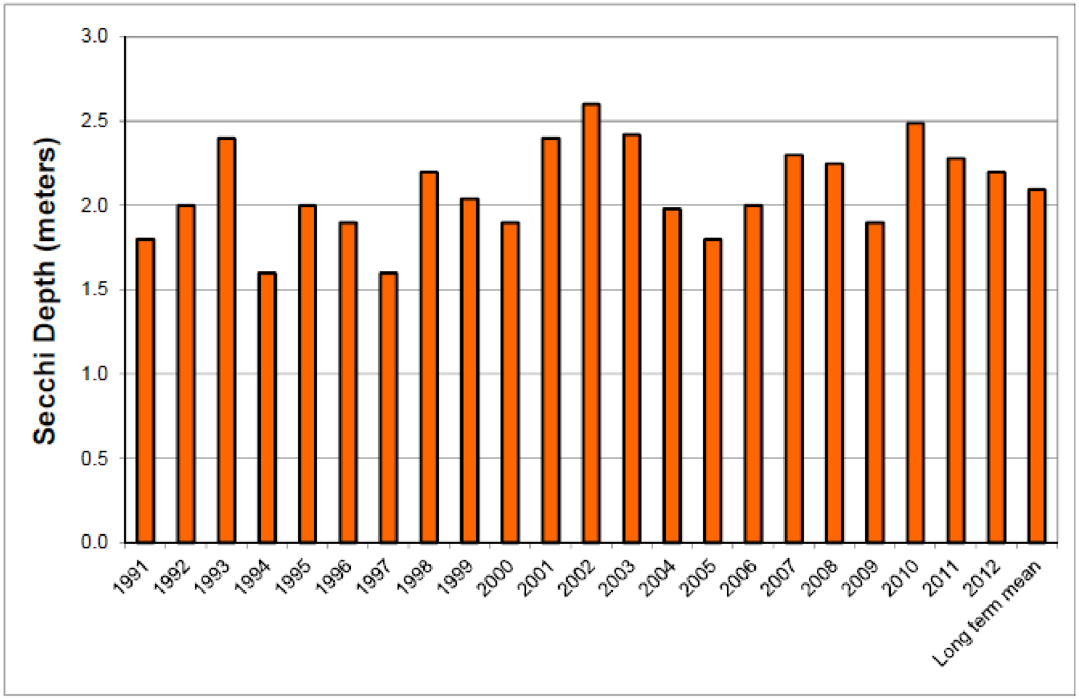


Figure 2 - Lake Hopatcong Long-Term Secchi Depth (meters)

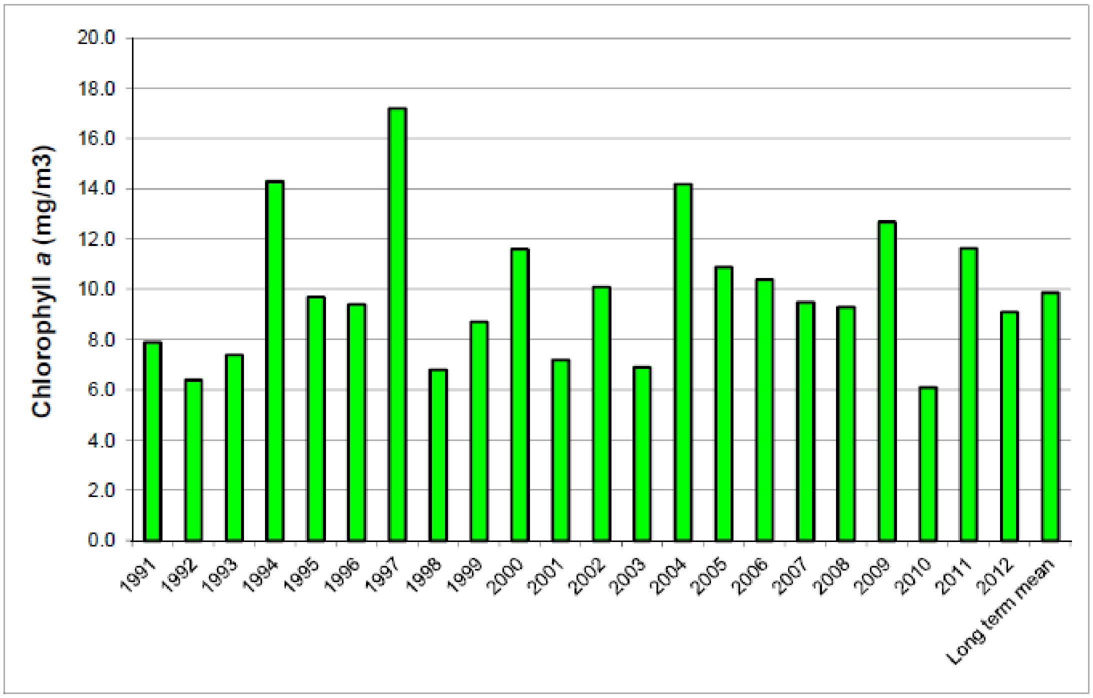


Figure 3 - Lake Hopatcong Long-Term Chlorophyll a Concentrations (mg/m3)

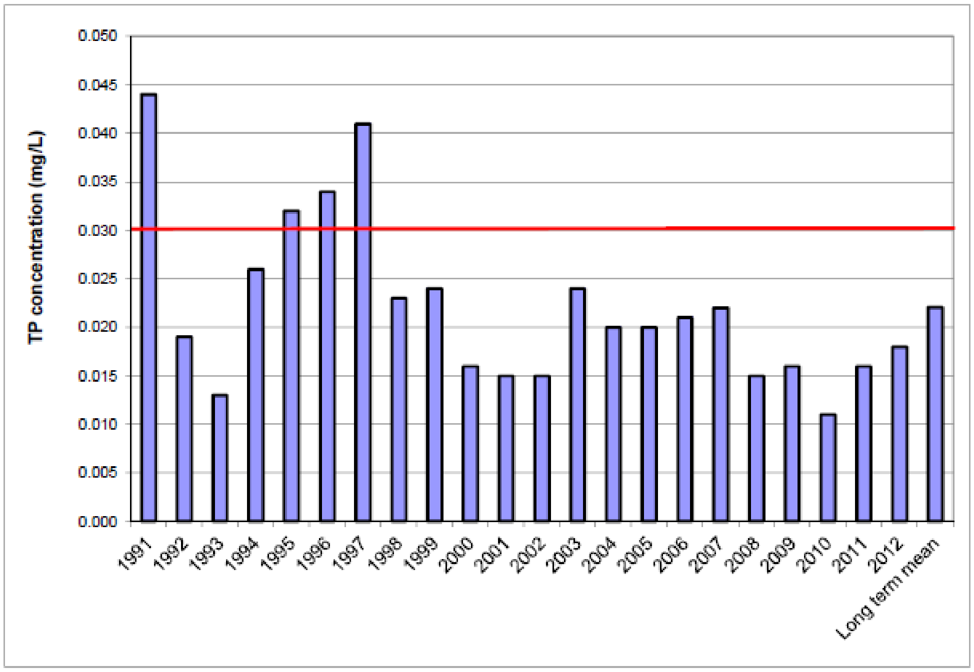


Figure 4 - Lake Hopatcong Long-Term Total Phosphorus Concentrations (mg/L)

APPENDIX B

IN-SITU DATA

***In-Situ* Monitoring for Lake Hopatcong 5/23/12**

Station	DEPTH (meters)			Temperature	SpC	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(°C)	(mS/cm)	(units)	(mg/L)	(%)
ST-1	1.9	1.9+	0.25	22.16	0.284	7.87	8.24	94.7
			1.0	21.77	0.284	7.85	8.51	97.0
			1.5	21.00	0.285	7.76	7.38	82.8
ST-2	13.7	2.5	0.25	20.32	0.29	8.68	9.17	101.6
			1.0	19.18	0.289	8.57	9.30	102.1
			2.0	19.28	0.292	8.46	9.11	102.2
			3.0	18.69	0.29	8.28	9.36	100.5
			4.0	18.32	0.293	8.17	9.22	98.1
			5.0	16.70	0.291	8.08	9.02	92.8
			6.0	15.06	0.291	7.95	8.33	84.4
			7.0	14.03	0.296	7.87	7.61	73.9
			8.0	13.25	0.294	7.74	5.51	52.7
			9.0	12.74	0.297	7.67	5.20	49.2
			10.0	12.41	0.298	7.62	4.91	46.0
			11.0	12.17	0.297	7.57	4.29	40.0
			12.0	11.97	0.301	7.49	3.69	34.3
			13.0	11.74	0.302	7.43	3.12	28.8
			13.5	11.39	0.303	7.36	2.13	19.6
ST-3*	1.5	1.5+	0.25	27.02	0.333	9.00	10.83	140.7
			1.0	25.68	0.359	9.25	12.14	148.0
ST-4	2.7	2.5	0.25	21.30	0.295	8.22	8.33	94.1
			1.0	20.28	0.296	8.13	7.95	88.2
			2.0	19.61	0.293	8.02	8.24	90.0
			2.5	19.34	0.294	7.84	6.82	73.7
ST-5	3	2.8	0.25	21.35	0.297	8.08	8.39	94.7
			1.0	20.70	0.297	8.17	8.15	91.0
			2.0	20.09	0.297	8.32	8.22	90.4
			2.5	18.75	0.311	7.76	1.34	14.3
ST-6	2.2	2.2+	0.25	22.28	0.277	8.59	9.55	110.0
			1.0	19.95	0.281	8.64	9.32	102.5
			2.0	18.37	0.296	8.18	6.41	68.3
ST-7	1.6	1.3	0.25	22.33	0.147	7.63	8.30	95.6
			1.0	20.82	0.167	7.56	8.42	94.2
			1.5	20.68	0.168	7.49	8.24	91.9
ST-8	7.5	2.5	0.25	19.92	0.289	8.00	9.26	101.8
			1.0	19.60	0.289	8.09	9.33	102.1
			2.0	19.30	0.288	8.11	9.40	102.3
			3.0	19.02	0.287	8.07	9.48	102.4
			4.0	18.48	0.29	8.01	9.30	99.5
			5.0	15.67	0.292	7.94	9.16	90.0
			6.0	14.78	0.296	7.86	8.20	81.0
			7.0	13.58	0.294	7.68	4.51	43.0
			7.5	12.79	0.297	7.58	4.30	41.0
ST-9	7.5	2.5	0.25	21.38	0.292	8.44	9.21	104.7
			1.0	21.24	0.289	8.42	9.19	103.2
			2.0	19.42	0.294	8.37	9.91	107.8
			3.0	18.52	0.293	8.23	9.40	100.4
			4.0	17.55	0.293	8.11	9.72	101.6
			5.0	16.79	0.294	7.95	8.78	92.5
			6.0	13.86	0.293	7.91	8.95	90.2
ST-10	1.5	1.5+	0.25	22.47	0.289	7.69	7.84	90.6
			1.0	21.19	0.284	7.77	7.96	89.7
			1.5	21.02	0.304	7.71	7.45	83.7
ST-11	1	1.0+	0.25	21.83	0.118	7.85	7.68	87.6
			1.0	20.80	0.122	7.72	7.42	83.0

***In-Situ* Monitoring for Lake Hopatcong 6/19/12**

Station	DEPTH (meters)			Temperature	SpC	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(°C)	(mS/cm)	(units)	(mg/L)	(%)
ST-1	2	1.2	0.25	22.39	287.4	7.67	8.17	96.8
			1.0	22.39	287.5	7.59	7.88	93.4
			2.0	22.39	287.3	7.57	7.75	91.8
ST-2	13.5	2.2	0.25	21.94	298.1	7.97	8.88	104.4
			1.0	21.93	298.3	7.77	3.05	35.8
			2.0	21.98	298.2	8.09	9.04	106.3
			3.0	21.98	298.3	8.08	9.07	106.7
			4.0	21.95	298.4	8.04	9.08	106.8
			5.0	20.8	298.3	7.77	8.81	101.3
			6.0	18.46	299.5	7.39	7.33	80.4
			7.0	15.72	302.6	7.16	6.56	67.9
			8.0	14.15	301.1	7.02	5.54	55.5
			9.0	13.23	302.1	6.93	3.71	36.4
			10.0	12.79	301.4	6.88	2.81	27.2
			11.0	12.52	304.9	6.85	2.08	20.1
			12.0	12.25	304.6	6.86	1.23	11.8
			13.0	11.84	314.4	6.88	0.83	7.9
ST-3	2.1	1.5	0.25	22.61	468.3	7.75	7.24	86.2
			1.0	22.33	452.6	7.74	6.99	82.8
			2.0	22.15	437	7.66	6.9	81.5
ST-4	3	1.7	0.25	22.21	304.9	7.55	8.04	95
			1.0	22.24	305	7.53	8.04	95
			2.0	22.25	304.9	7.53	8.04	95
			3.0	21.72	299.1	7.18	6.59	77.1
ST-5	2.5	1.7	0.25	22.56	309	6.78	6.75	80.3
			1.0	22.64	309.5	7.19	6.95	82.7
			2.0	22.61	309.6	7.37	7.26	86.4
ST-6	2.4	1.5	0.25	22.62	291.8	7.61	8.48	100.9
			1.0	22.6	292.2	7.47	7.97	94.9
			2.0	22.55	291.8	7.42	7.72	91.8
ST-7	1.9	1	0.25	21.79	144.6	7.2	8.79	103
			1.0	21.67	147.8	7	7.77	90.8
			1.5	21.66	147.9	6.96	7.4	86.4
ST-8	8	2	0.25	22.28	297.1	7.98	8.73	103.3
			1.0	22.3	297.3	8.01	8.79	104.1
			2.0	22.3	297.3	8	8.84	104.6
			3.0	22.23	298.7	7.87	8.86	104.7
			4.0	22.17	299.1	7.78	8.78	103.7
			5.0	21.95	306.9	7.65	8.63	101.4
			6.0	18.39	300.2	7.43	7.77	85
			7.0	16.01	304.4	7.15	6.28	65.4
			8.0	15.83	308.3	7.01	5.17	53.7
ST-9	8	2.1	0.25	22.89	297.3	7.93	9.23	110.4
			1.0	22.85	297.3	8.01	9.2	110
			2.0	22.81	297.1	7.98	9.15	109.4
			3.0	22.72	298	7.8	9.02	107.6
			4.0	22.52	295.8	7.72	8.74	103.9
			5.0	21.72	296.9	7.53	8.41	98.4
			6.0	19.01	298.8	7.29	8.16	90.5
			7.0	16.36	302.8	6.97	5.85	61.4
			8.0	14.5	332	7.03	2.75	27.7
ST-10	1.5	1.3	0.25	22.07	299.5	8.42	9.45	111.4
			1.0	22.05	299.8	8.44	9.23	108.6
			1.5	22.03	301.7	8.42	9.17	108
ST-11	1.1	0.9	0.25	21.19	120	7.39	8.27	95.7
			1.0	21.19	120.1	7.08	7.63	88.3

***In-Situ* Monitoring for Lake Hopatcong 7/24/12**								
Station	**DEPTH (meters)**			**Temperature**	**SpC**	**pH**	**Dissolved Oxygen**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(°C)**	**(mS/cm)**	**(units)**	**(mg/L)**	**(%)**
ST-1	**1.9**	**0.95**	**0.25**	26.94	0.294	7.67	8.39	108.2
			1.0	26.74	0.293	7.64	8.47	108.9
			1.5	26.44	0.292	7.56	8.50	108.6
ST-2	**14.5**	**1.7**	**0.25**	25.43	0.304	7.72	8.08	101.4
			1.0	25.36	0.304	7.72	8.07	101.1
			2.0	25.17	0.304	7.70	8.07	100.8
			3.0	25.04	0.304	7.65	8.05	100.3
			4.0	25.01	0.304	7.61	7.92	98.7
			5.0	24.83	0.304	7.55	7.83	97.2
			6.0	21.95	0.298	7.23	5.73	67.3
			7.0	17.90	0.297	6.92	3.60	39.1
			8.0	15.77	0.307	6.84	1.96	20.3
			9.0	13.90	0.306	6.85	1.36	13.6
			10.0	13.22	0.308	6.84	0.87	8.5
			11.0	12.70	0.310	6.87	0.49	4.7
			12.0	12.38	0.315	6.92	0.26	2.5
			13.0	11.89	0.323	7.00	0.18	1.7
			14.0	11.72	0.335	7.05	0.14	1.3
			14.5	11.73	0.366	7.12	0.11	1.0
ST-3	**2.1**	**0.8**	**0.25**	27.66	0.406	8.78	10.90	142.5
			1.0	25.51	0.374	8.73	11.62	146.0
			2.0	24.97	0.398	6.85	6.58	81.9
ST-4	**2.6**	**1.5**	**0.25**	25.55	0.310	7.57	7.99	100.5
			1.0	25.41	0.309	7.57	8.02	100.6
			2.0	25.33	0.310	7.56	8.02	100.5
			2.5	25.23	0.325	7.19	7.13	89.2
ST-5	**2.3**	**1.1**	**0.25**	25.93	0.312	7.21	6.08	76.9
			1.0	24.98	0.310	7.30	6.73	83.8
			2.0	24.92	0.311	7.22	6.86	85.3
ST-6	**2.2**	**1.2**	**0.25**	26.87	0.303	7.92	8.25	106.3
			1.0	26.76	0.303	7.94	8.67	111.5
			2.0	26.29	0.303	7.88	8.92	113.7
ST-7	**1.6**	**1.6+**	**0.25**	26.35	0.303	7.39	7.86	100.4
			1.0	25.90	0.300	7.45	8.13	102.9
			1.5	25.68	0.311	7.33	8.27	104.3
ST-8	**6.5**	**1.75**	**0.25**	25.79	0.305	7.77	7.93	100.2
			1.0	25.79	0.305	7.75	8.00	101.1
			2.0	25.78	0.305	7.75	8.01	101.2
			3.0	25.71	0.305	7.77	8.04	101.5
			4.0	25.64	0.305	7.79	8.06	101.6
			5.0	25.64	0.305	7.79	8.08	101.8
			6.0	25.60	0.305	7.77	8.11	102.1
			6.5	25.15	0.312	7.36	6.77	84.5
ST-9	**8**	**1.8**	**0.25**	26.45	0.304	7.77	8.26	105.6
			1.0	26.43	0.304	7.77	8.34	106.6
			2.0	25.18	0.302	7.65	8.53	106.5
			3.0	25.07	0.302	7.48	8.34	104.0
			4.0	24.77	0.302	7.34	7.72	95.7
			5.0	23.20	0.300	6.93	5.05	60.8
			6.0	19.87	0.295	6.74	2.46	27.8
			7.0	17.96	0.306	6.73	1.54	16.7
			8.0	16.65	0.315	6.78	0.93	9.8
ST-10	**1.5**	**1**	**0.25**	26.97	0.303	7.81	8.19	105.7
			1.0	26.24	0.299	7.68	8.51	108.4
			1.5	26.18	0.300	7.55	8.50	108.1
ST-11	**1**	**1.0+**	**0.25**	25.97	0.247	7.32	8.17	103.6
			1.0	24.79	0.258	7.17	8.37	103.8

In-Situ Monitoring for Lake Hopatcong 8/27/12								
Station	DEPTH (meters)			Temperature	SpC	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(°C)	(mS/cm)	(units)	(mg/L)	(%)
ST-1	2.1	0.9	0.25	25.57	0.294	7.66	7.85	98.8
			1.0	25.58	0.294	7.43	7.66	96.4
			2.0	25.47	0.295	7.40	7.67	96.4
ST-2	13.9	2.3	0.25	25.31	0.302	7.65	8.41	105.4
			1.0	25.31	0.302	7.69	8.42	105.5
			2.0	25.29	0.302	7.70	8.43	105.5
			3.0	25.27	0.302	7.70	8.44	105.6
			4.0	25.26	0.302	7.70	8.45	105.7
			5.0	24.81	0.301	7.52	7.75	96.2
			6.0	23.64	0.298	7.08	5.15	62.6
			7.0	20.36	0.289	6.63	1.60	18.3
			8.0	16.84	0.311	6.60	1.25	13.2
			9.0	14.52	0.324	6.67	0.79	8.0
			10.0	13.38	0.329	6.76	0.45	4.4
			11.0	12.76	0.326	6.80	0.28	2.7
			12.0	12.32	0.326	6.90	0.17	1.6
			13.0	11.85	0.336	6.95	0.10	1.0
			13.5	11.70	0.448	6.84	0.06	0.5
ST-3	2	0.7	0.25	26.25	0.340	7.90	8.38	106.8
			1.0	25.55	0.353	8.18	8.61	108.3
			2.0	24.97	0.350	7.60	8.21	102.1
ST-4	3	1.2	0.25	25.61	0.304	7.50	8.07	101.6
			1.0	25.58	0.304	7.47	8.04	101.2
			2.0	25.52	0.303	7.46	8.05	101.2
			3.0	25.47	0.304	7.45	8.03	100.8
ST-5	3.1	1.4	0.25	25.83	0.306	7.90	8.72	110.2
			1.0	25.83	0.306	7.92	8.76	110.7
			2.0	25.52	0.306	7.73	8.35	105.0
			3.0	25.34	0.306	7.56	7.97	99.8
ST-6	2.3	1.5	0.25	26.28	0.301	7.56	8.21	104.6
			1.0	25.92	0.301	7.55	8.30	105.1
			2.0	25.59	0.301	7.51	8.33	104.9
			2.3	25.59	0.304	7.51	8.32	104.8
ST-7	2.3	2.3+	0.25	25.77	0.258	7.28	7.89	99.6
			1.0	25.81	0.257	7.28	7.87	99.4
			2.0	25.03	0.268	7.22	7.90	98.5
			2.3	24.89	0.274	7.21	7.83	97.2
ST-8	7.4	2.4	0.25	25.46	0.300	7.73	8.46	106.3
			1.0	25.27	0.300	7.78	8.53	106.7
			2.0	25.15	0.300	7.78	8.55	106.8
			3.0	25.13	0.300	7.77	8.55	106.7
			4.0	25.08	0.301	7.76	8.54	106.5
			5.0	25.01	0.301	7.71	8.45	105.2
			6.0	23.55	0.298	7.21	5.60	67.9
			7.0	20.54	0.292	6.79	2.45	28.0
			7.3	19.74	0.298	6.78	1.61	18.1
ST-9	8	2.6	0.25	26.09	0.303	7.74	8.49	107.8
			1.0	25.75	0.303	7.78	8.57	108.2
			2.0	25.64	0.303	7.80	8.62	108.6
			3.0	25.58	0.303	7.79	8.67	109.2
			4.0	25.53	0.302	7.77	8.67	109.0
			5.0	25.45	0.302	7.72	8.65	108.6
			6.0	25.00	0.301	7.56	8.10	100.8
			7.0	22.44	0.296	7.10	5.82	69.0
			8.0	17.49	0.334	6.89	2.69	28.9
ST-10	1.5	0.9	0.25	25.73	0.306	7.80	8.36	105.5
			1.0	25.62	0.308	7.87	8.40	105.8
			1.5	25.34	0.314	8.05	8.47	106.1
ST-11	1.2	1.2+	0.25	24.34	0.211	7.21	7.61	93.6
			1.0	24.12	0.209	7.15	7.63	93.4

In-Situ Monitoring for Lake Hopatcong 9/25/12								
Station	**DEPTH (meters)**			**Temperature**	**SpC**	**pH**	**Dissolved Oxygen**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(°C)**	**(mS/cm)**	**(units)**	**(mg/L)**	**(%)**
ST-1	**1.9**	**1.5**	**0.25**	18.55	0.291	7.98	9.32	102.4
			1.0	18.47	0.291	7.97	9.35	102.5
			1.5	18.18	0.288	7.96	9.39	102.4
ST-2	**14**	**2.5**	**0.25**	19.60	0.294	7.50	8.36	93.8
			1.0	19.60	0.294	7.45	8.15	91.4
			2.0	19.60	0.294	7.43	8.05	90.3
			3.0	19.59	0.294	7.39	7.97	89.4
			4.0	19.59	0.294	7.37	7.93	89.0
			5.0	19.59	0.294	7.34	7.88	88.4
			6.0	19.58	0.294	7.32	7.85	88.1
			7.0	19.57	0.294	7.31	7.83	87.9
			8.0	19.56	0.294	7.30	7.82	87.7
			9.0	19.55	0.294	7.26	7.75	86.8
			10.0	15.72	0.333	6.95	4.31	44.6
			11.0	13.60	0.340	6.96	1.68	16.6
			12.0	12.81	0.341	6.97	0.93	9.1
			13.0	12.36	0.339	6.95	0.59	5.7
			14.0	11.97	0.355	6.91	0.29	2.8
ST-3	**2.1**	**1.1**	**0.25**	19.22	0.317	7.49	8.94	99.6
			1.0	18.64	0.320	7.50	8.88	97.7
			2.0	18.29	0.321	7.45	8.70	95.1
ST-4	**3.2**	**2**	**0.25**	18.46	0.294	7.99	9.12	100.0
			1.0	18.45	0.294	7.94	9.09	99.7
			2.0	18.43	0.294	7.90	9.07	99.4
			3.0	18.48	0.294	7.88	9.03	99.0
ST-5	**3.5**	**2**	**0.25**	18.29	0.291	7.58	8.85	96.7
			1.0	18.29	0.292	7.69	8.89	97.2
			2.0	18.29	0.292	7.78	8.92	97.4
			3.0	18.22	0.291	7.86	8.96	97.7
			3.5	18.23	0.292	7.82	8.95	97.7
ST-6	**2.5**	**2.5+**	**0.25**	19.12	0.292	8.07	9.41	104.6
			1.0	19.11	0.292	8.20	9.52	105.8
			2.0	18.51	0.292	8.38	9.66	106.1
			2.5	18.62	0.298	8.27	7.92	87.1
ST-7	**1.5**	**1.5+**	**0.25**	17.48	0.278	7.31	9.05	97.3
			1.0	17.24	0.277	7.30	8.79	94.0
			1.5	17.11	0.274	7.28	8.57	91.4
ST-8	**7.25**	**2.3**	**0.3**	19.75	0.294	7.49	8.91	100.2
			1.0	19.72	0.294	7.51	8.55	96.2
			2.0	19.71	0.294	7.52	8.45	95.0
			3.0	19.68	0.294	7.52	8.40	94.4
			4.0	19.63	0.294	7.51	8.36	93.9
			5.0	19.61	0.294	7.51	8.36	93.9
			6.0	19.52	0.294	7.51	8.37	93.8
			7.0	19.09	0.296	7.41	8.13	90.3
			7.3	19.19	0.321	7.13	8.07	89.8
ST-9	**8**	**2.2**	**0.25**	19.90	0.295	7.55	7.92	89.4
			1.0	19.86	0.295	7.48	7.74	87.3
			2.0	19.60	0.294	7.46	7.66	86.0
			3.0	19.54	0.294	7.41	7.54	84.5
			4.0	19.51	0.294	7.38	7.42	83.1
			5.0	19.45	0.294	7.37	7.38	82.6
			6.0	19.44	0.295	7.33	7.28	81.5
			7.0	19.39	0.295	7.31	7.21	80.5
			8.0	19.14	0.390	6.96	2.69	30.0
ST-10	**1.5**	**1.5+**	**0.25**	18.67	0.294	7.94	9.44	104.0
			1.0	17.79	0.312	8.27	9.63	104.2
			1.5	17.69	0.325	8.59	9.92	107.1
ST-11	**1**	**1.0+**	**0.25**	16.46	0.185	7.14	8.93	93.9
			1.0	16.12	0.186	7.03	8.23	86.0

In-Situ Monitoring for Hopatcong 319 Stations 5/23/12									
Station	**DEPTH (meters)**			**Temperature**	**SpC**	**pH**	**Dissolved Oxygen**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(°C)**	**(mS/cm)**	**(units)**	**(mg/L)**	**(%)**
NPS 1	**1.2**	**1.2+**	0.25	26.99	0.490	8.31	10.21	127.2
			1.00	22.76	0.595	8.16	10.13	118.7
NPS 2	**0.7**	**0.7+**	0.25	22.19	0.238	7.79	8.44	96.9
			0.50	21.84	0.239	7.80	7.74	89.0
NPS 3	**0.95**	**0.95+**	0.25	22.46	0.267	7.75	8.20	94.7
			0.50	22.03	0.270	7.74	8.19	93.8
NPS 4	**1.2**	**1.2+**	0.25	21.61	0.294	8.05	8.37	95.0
			1.00	19.60	0.389	8.78	12.89	140.7
NPS 5	**1.6**	**1.6+**	0.25	21.71	0.301	8.16	7.85	89.4
			1.00	20.67	0.299	8.17	7.97	88.9
			1.50	20.45	0.298	8.14	7.61	84.2

In-Situ Monitoring for Hopatcong 319 Stations 6/19/12								
Station	**DEPTH (meters)**			**Temperature**	**SpC**	**pH**	**Dissolved Oxygen**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(°C)**	**(mS/cm)**	**(units)**	**(mg/L)**	**(%)**
NPS 1	**2.5**	**0.7**	0.25	22.09	0.589	7.40	5.67	66.9
			1.00	22.06	0.585	7.38	5.37	63.3
			2.00	21.85	0.601	7.33	5.18	60.8
NPS 2	**1.2**	**1.2+**	0.25	22.12	0.231	8.02	8.66	102.2
			1.00	22.15	0.232	8.22	8.88	104.8
NPS 3	**0.7**	**0.7+**	0.25	22.38	0.285	8.00	9.19	108.9
			0.50	22.30	0.284	8.36	9.13	108.0
NPS 4	**1.4**	**1.4+**	0.25	22.05	0.312	7.43	8.08	95.2
			1.00	22.02	0.314	7.36	7.77	91.4
NPS 5	**1**	**1.0+**	0.25	22.47	0.310	7.49	7.59	90.2
			1.50	22.44	0.310	7.46	7.50	89.0

***In-Situ* Monitoring for Hopatcong 319 Stations 7/24/12**

Station	DEPTH (meters)			Temperature	SpC	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(°C)	(mS/cm)	(units)	(mg/L)	(%)
NPS 1	1.5	0.65	0.25	27.36	0.412	8.49	9.28	120.6
			1.00	25.24	0.412	8.17	9.98	124.8
			1.50	24.96	0.411	7.65	9.38	116.7
NPS 2	1	1.0+	0.25	25.97	0.292	8.17	8.79	111.4
			1.00	25.24	0.292	8.39	8.96	112.1
NPS 3	0.95	0.95+	0.25	27.31	0.275	8.45	9.07	117.7
			0.90	25.53	0.281	7.69	9.47	119.0
NPS 4	1.6	1.1	0.25	25.90	0.315	7.66	8.05	101.8
			1.00	25.77	0.316	7.64	8.11	102.4
			1.50	25.53	0.323	7.52	8.12	102.1
NPS 5	2.3	1.1	0.25	25.51	0.314	7.53	7.86	98.8
			1.00	25.25	0.312	7.54	7.92	99.1
			2.00	24.92	0.314	7.45	7.92	98.4
			2.25	24.90	0.314	7.28	7.40	92.0

***In-Situ* Monitoring for Hopatcong 319 Stations 8/27/12**

Station	DEPTH (meters)			Temperature	SpC	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(°C)	(mS/cm)	(units)	(mg/L)	(%)
NPS 1	1.5	0.5	0.25	26.82	0.383	8.50	9.42	121.3
			1.00	25.55	0.372	7.88	8.67	109.0
			1.50	25.52	0.372	7.69	7.81	98.2
NPS 2	1	1+	0.25	25.78	0.148	7.50	8.19	103.5
			1.00	25.75	0.280	7.66	8.28	104.5
NPS 3	0.9	0.9+	0.25	25.84	0.282	8.27	8.95	113.2
			0.90	25.06	0.288	7.68	7.20	89.8
NPS 4	1.7	1.1	0.25	25.54	0.313	7.41	7.79	97.9
			1.00	25.50	0.310	7.37	7.68	96.5
			1.50	25.23	0.334	7.24	7.26	90.8
NPS 5	2.5	1.2	0.25	25.45	0.306	7.67	8.27	103.8
			1.00	25.44	0.306	7.68	8.28	104.0
			2.00	25.39	0.307	7.66	8.29	104.0
			2.50	25.34	0.308	7.53	7.65	95.9

***In-Situ* Monitoring for Hopatcong 319 Stations 9/25/12**									
Station	**DEPTH (meters)**			**Temperature**	**SpC**	**pH**	**Dissolved Oxygen**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(°C)**	**(mS/cm)**	**(units)**	**(mg/L)**	**(%)**
NPS 1	**1.5**	**1**	**0.25**	17.99	0.354	7.77	9.38	101.9
			1.00	17.91	0.351	7.78	9.35	101.4
			1.50	17.78	0.350	7.54	9.31	100.7
NPS 2	**1**	**1.0+**	**0.25**	16.88	0.281	7.43	8.80	93.4
			1.00	16.80	0.281	7.45	8.66	91.7
NPS 3	**0.8**	**0.8+**	**0.25**	16.93	0.279	7.45	9.33	99.1
			0.80	16.60	0.279	7.51	9.21	97.2
NPS 4	**1.5**	**1.5+**	**0.25**	17.72	0.296	8.10	9.32	100.7
			1.00	17.31	0.300	8.13	9.33	100.0
			1.50	17.16	0.305	7.87	9.28	99.1
NPS 5	**15**	**1.5+**	**0.25**	17.91	0.291	8.15	9.20	99.7
			1.00	17.83	0.292	8.30	9.17	99.3
			1.50	17.66	0.291	8.42	9.27	100.0

APPENDIX C

WATER QUALITY DATA

HOPATCONG
23-May-2012

STATION	Chlorophyll (mg/m³)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	5.4	0.02	0.04	0.02	3
ST-2	4.0	0.02	ND <0.02	0.02	ND <3
ST-3	1.2	0.03	ND <0.02	0.02	ND <3
ST-4	3.4	0.02	ND <0.02	0.02	ND <3
ST-5	1.9	0.02	ND <0.02	0.02	ND <3
ST-6	6.8	0.01	ND <0.02	0.02	ND <3
ST-7	6.3	0.01	0.07	0.03	4
ST-10	4.8	0.02	0.03	0.02	ND <3
ST-11	58.2	0.03	0.39	**0.05**	22
ST-2 DEEP		0.42	0.06	0.10	3
MEAN	**10.2**	**0.02**	**0.06**	**0.02**	**4.2**

HOPATCONG
19-Jun-12

STATION	Chlorophyll (mg/m³)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	15.3	0.02	0.04	0.03	6
ST-2	9.7	0.02	ND <0.02	0.01	3
ST-3	11	0.05	0.12	**0.04**	3
ST-4	8.3	0.02	0.04	0.03	5
ST-5	8.9	0.02	0.02	0.02	6
ST-6	8.9	0.02	0.04	0.02	ND <3
ST-7	22.7	0.02	0.10	**0.04**	4
ST-10	12.4	0.02	0.06	0.02	5
ST-11	20.9	0.04	0.12	**0.04**	6
ST-2 DEEP		0.26	0.04	0.02	3
MEAN	**13.1**	**0.03**	**0.06**	**0.03**	**4.3**

HOPATCONG
24-Jul-12

STATION	Chlorophyll (mg/m³)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	19.6	0.03	0.03	0.03	10
ST-2	12.2	0.02	0.03	0.02	ND <3
ST-3	67.7	ND <0.01	0.05	**0.06**	9
ST-4	20.5	0.03	0.03	0.03	ND <3
ST-5	20.3	0.03	0.03	0.03	4
ST-6	14.8	0.03	0.02	0.03	3
ST-7	4.3	0.01	0.03	0.02	ND <3
ST-10	25.4	ND <0.01	0.03	**0.04**	7
ST-11	6.9	0.03	0.07	0.03	ND <3
ST-2 DEEP		0.60	0.04	0.14	4
MEAN	**21.3**	**0.02**	**0.04**	**0.03**	**4.3**

HOPATCONG
27-Aug-12

STATION	Chlorophyll (mg/ m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	20	ND <0.01	0.04	0.03	8
ST-2	8.7	0.01	ND <0.02	0.01	2
ST-3	37	0.02	0.04	**0.05**	6
ST-4	16	0.04	0.03	0.02	3
ST-5	20	ND <0.01	0.03	0.03	5
ST-6	7.9	ND <0.01	ND <0.02	0.02	4
ST-7	3.1	0.01	0.03	0.02	2
ST-10	23	0.01	0.08	**0.04**	10
ST-11	4.7	ND <0.01	0.04	0.02	2
ST-2 DEEP		1.70	0.10	0.35	10
MEAN	**15.6**	**0.30**	**0.05**	**0.03**	**5.2**

HOPATCONG
25-Sep-12

STATION	Chlorophyll (mg/ m^3)	NH3-N (mg/L)	NO3-N (mg/L)	TP (mg/L)	TSS (mg/L)
ST-1	10	0.03	ND <0.02	**0.04**	2
ST-2	11	0.03	ND <0.02	0.03	2
ST-3	33	0.03	0.03	**0.05**	5
ST-4	7.7	0.03	ND <0.02	0.02	2
ST-5	8.6	0.03	ND <0.02	0.03	2
ST-6	5.9	0.06	0.02	**0.04**	ND <2
ST-7	1.9	0.09	ND <0.02	0.01	ND <2
ST-10	13	0.03	0.02	0.02	3
ST-11	3.2	0.03	0.04	0.02	ND <2
ST-2 DEEP		1.50	0.08	0.26	9
MEAN	**10.5**	**0.19**	**0.04**	**0.03**	**3.6**

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5/23/2012

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.04	3	
NPS 2	0.02	ND <3	
NPS 3	0.02	ND <3	3.1
NPS 4	0.02	3	4.4
NPS 5	0.02	ND <3	1.9

6/19/2012

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.06	9	
NPS 2	0.02	ND <3	
NPS 3	0.01	ND <3	7.4
NPS 4	0.04	3	19
NPS 5	0.02	4	7.2

7/24/2012

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.07	4	
NPS 2	0.02	ND <3	
NPS 3	0.03	3	12.7
NPS 4	0.02	3	16.4
NPS 5	0.03	3	16.8

8/27/2012

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.08	10	
NPS 2	0.01	ND <2	
NPS 3	0.03	3	12.5
NPS 4	0.03	5	15.9
NPS 5	0.02	5	17.1

9/25/2012

Station	TP (mg/L)	TSS (mg/L)	CHL *a* (mg/m^3)
NPS 1	0.03	5	
NPS 2	0.01	ND <2	
NPS 3	0.02	ND <2	6.4
NPS 4	0.02	2	5.8
NPS 5	0.01	2	6