Culver Lake
Mid-Year Report
August 2012

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The following report provides a mid-year synopsis of the observations and data compiled to date by Princeton Hydro over the course of the 2011 lake monitoring program. To date, sampling was conducted on 24 May 2012 (late spring) and 17 July 2012 (mid-summer). Both *in-situ* monitoring and discrete water testing of the lake and its inlets were conducted during each of these sampling events.

The primary purpose of this sampling program is to conduct *in-situ* monitoring of key environmental parameters and collect samples for water quality, phytoplankton and zooplankton characterization. These data are used to guide the Normanoch Association in the management of the lake and assess short- and long-term water quality conditions that affect the lake's ecological, aesthetic and recreational properties. Princeton Hydro's efforts this year have again focused on the lake's biology, specifically the occurrence and density of nuisance, invasive aquatic macrophytes (weeds), and an assessment of the composition and diversity of the lake's phytoplankton and zooplankton communities. In addition, as was begun in 2008, *in-situ* and water quality data has been collected from the lake's two main inlets, the Causeway Cove Brook and Owassa Brook.

Both the *in-situ* and discrete data collected during both 2012 sampling events (May and July) are discussed in this mid-year report. In addition, the lake was stocked with herbivorous zooplankton during the May monitoring event and a detailed survey was conducted of the lake's weed community. The last in-lake sampling and zooplankton stocking event is scheduled for mid-September, and will coincide as best as possible with the lake's seasonal turn over. To date, we have received none of the water quality data collected by Ecosystem Consulting Services (ECS) or specifics from Aquatic Technologies concerning the weed control program. However, *in-situ* data has been collected and subsequently forwarded to us from the community volunteers. In November, Princeton Hydro will prepare and present to the Association an End-of-Year report that integrates all the data, including that compiled by ECS, the volunteers and Aquatic Technologies. That report will detail our findings and conclusions of the lake's condition over the course of the 2012 growing season.

1. WATER QUALITY - TEMPERATURE AND DISSOLVED OXYGEN

During the 24 May 2012 event the lake was already becoming thermally stratified. Specifically, at the time of sampling, a significant decrease in water temperature was measured from surface to bottom. Additionally, at that time depressed dissolved oxygen (DO) concentrations (<2.0 mg/L) were measured at depths greater than 13 meters. Such conditions are reflective of the warm late spring/early summer season experienced through mid-May.

During the 17 July event, thermal and DO conditions were different relative to those observed during the 24 May event, with DO concentrations supersaturated (> 9 mg/L) at depths to only 2.0 meters. This was most likely the result of a surficial water algal bloom. DO concentrations in the "habitat zone" of the lake (depths between 4 and 7 meters) were reduced, especially at the 4 to 5 meter interface. As would be expected, between the May and July sampling events, surface water temperatures had risen, coinciding with the warming ambient air temperatures. Additionally during the 17 July event, with thermal stratification observed starting at a depth of 4.0 meters, the deeper waters were anoxic throughout, with the measured DO concentrations <1.0 mg/L at depths greater than 8 meters. Based on these observed data, the majority of the lake's deep cold waters did not have enough dissolved oxygen to sustain trout. Optimal cold water fishery habitat conditions were limited to a very small portion of the lake's water column, basically that associated with water depths of approximately 4 meters.

The water temperatures of the inlets were also reflective of the local ambient conditions. The stream temperatures are more susceptible to changes than are the waters of the lake due to flow, size and volume differences between the two. The dissolved oxygen concentrations measured at both inlets stations were as to be expected as based on ambient temperature. This is most likely the result of increased base flows in conjunction with the cooler spring water temperatures and consistent precipitation events in the spring. All of these factors would increase oxygen saturation of the water and contribute to the higher measured DO concentrations. However, it should be noted that the Causeway Inlet is much more reflective of the temperatures of the lake due to its size and slow-moving flow. For the Causeway Inlet station this is also likely a function of increased biological oxygen demand associated with the decomposition of the organic material in the upgradient wetland areas that drain to this station. As the summer progresses and bacterial respiration increases, declines in DO are to be expected, especially in wetland areas. The effect of this was also observed in the DO measured within the lake proper at bottom depths at the Causeway Cove station (Table 2).

The pH in Culver Lake varied from 6.83 to 9.17 to this point in the 2012 monitoring season. The lowest pH value was measured on 24 May, while the highest was measured on 17 July. The elevated or alkaline pH values measured on 17 July were most likely due to elevated rates of algal photosynthesis in the surface waters. As rates of photosynthesis increase, the pH of the surrounding waters will increase. The optimal range of pH for most aquatic organisms varies from 6.0 to 9.0. Thus, to date, the pH of Culver Lake was for the most part within the optimal range for most aquatic life, with the exception being the surface waters in mid-July.

In contrast to the lake data, the pH measured at the inlet stations showed less variation between the May and July sampling dates, but did become less alkaline between the May and July events. These data show that photosynthesis-driven pH changes are more pronounced for the lake than for the streams. The data also show that whether due to photosynthesis, changes in surface runoff and groundwater recharge or some other factor the pH of the streams also became less alkaline moving from spring into summer, most likely due to the overall lack of precipitation.

2. WATER CLARITY

The clarity goal for Culver Lake is to sustain Secchi depths of at least 1 m (3.3 ft) or greater throughout the course of the growing season (April through September). The lake's Secchi disk clarity, as measured at the mid-lake station, was exceptional in May; 1.9 meters or 6.2 feet. The Secchi clarity measured at the Stehr Tract and Causeway Inlet stations in May also exceeded the 1.0 meter threshold (Table 1). In July the lake's water clarity (as measured at mid-lake) dropped relative to the May measurement, and had dipped below the lake's clarity threshold (0.9 meters vs. 1.0 meter threshold). However, Secchi clarity in July remained acceptable at the Stehr Tract (1.0 meters) and at the Causeway Inlet (1.2 meters) stations. To date, the lake's clarity for 2012 has been slightly lower than the May and July 2011 Secchi values. Photos of these respective secchi depth observations are attached to the end of this report.

3. NUTRIENTS

Princeton Hydro has received the lab results for both the May and July sampling events. The total phosphorus (TP) concentrations measured in the lake in May 2012 were already elevated for the surface and mid-depth samples with concentrations of 0.03 mg/L and 0.05 mg/L respectively. In addition, the deep sample TP concentration was profoundly elevated at 0.29 mg/L. The May 2012 TP concentrations are not consistent with Culver Lake's typical long term spring TP concentrations. TP concentrations equal to or greater than 0.06 mg/L tend to be associated with nuisance algal blooms. Thus the lake's maintenance plan aims for TP levels below the 0.06 mg/L threshold. While the spring surface and mid-depth TP concentrations were below this threshold, they were elevated compared to the long-term averages.

TP concentrations measured in the lake in July 2012 had dropped to 0.02 mg/L at the surface and at mid-depth, while the deep sample's TP concentration was again elevated at 0.16 mg/L. Similar to May, these TP concentrations were consistent with the long term data base. What is important is that the July concentrations, which were lower than the May concentrations continued to be below the 0.06 mg/L threshold.

During the May and July monitoring events, while the nitrate-N concentrations were minimal (< 0.3 mg/l) at all stations, the 2012 nitrate data were slightly above what has been consistent with the long-term database. Ammonia-N concentration as sampled in upper portions of the lake's water column was low in both May and July (< 0.10 mg/L). However, the concentration of ammonia-N measured in the deeper portion of the water column was elevated in both May (0.55 mg/L) and July (0.58 mg/L). However, this is not unexpected as deep water ammonia-N concentrations will be higher than surface water concentrations due largely to bacterial decomposition of settled organic material and the lack of any photosynthetic uptake. Bottom water ammonia concentrations will further increase over the course of growing season if the lake's hypolimnion remains anoxic.

The TP of the water entering the lake at the two inlet stations was also measured. In May, the Causeway Cove TP concentration was 0.06 mg/L, and the concentration of TP measured at the Rt. 206 Inlet was 0.05 mg/L. In July, the TP concentration in the water entering the lake at Causeway was reduced when compared to the May concentration at 0.03 mg/L, while the TP concentration measured at the Rt. 206 Inlet was higher in concentration at 0.06 mg/L. The nitrate-N concentrations measured at the inlets were minimal during both events; < 0.25 mg/L.

The total suspended solids (TSS) concentrations measured in both streams in May were low, but still detectable in the Causeway Cove Inlet at 14 mg/L and < 2 mg/L at the Route 206 Inlet. The TSS concentrations measured in both streams in July remained low, but still detectable in the Causeway Cove Inlet at 5 mg/L and again < 2 mg/L at the Route 206 Inlet. At TSS concentrations greater than 25 mg/L water will appear "muddy" or "turbid". The lower concentrations measured this year in May and July probably are a reflection of limited rainfall, runoff, and stream bed/bank scour, all of which will cause the streams to carry more particulate material into the lake. The concentration of TSS is also important with respect to phosphorus loading to the lake. Phosphorus binds well to sediments, so typically as TSS concentrations increase so will TP concentrations. Thus tracking TSS concentrations can provide insight into the rate and amount of TP entering the lake from watershed sources.

4. PHYTOPLANKTON AND ZOOPLANKTON

During the 24 May sampling event the overall amount of phytoplankton measured in the water column was relatively minimal. The lake's May phytoplankton community was dominated by blue-green algae, along with a diverse assemblage of green algae, cryptomonads, diatoms and golden algae. This is important as it shows that even in an environment where TP concentrations are low; conditions favoring the development of blue-green algae still persist. In the surface water sample the single dominant blue-green genus was *Anabaena* and of the chrysophytes the dominant species was *Chromulina*. This has been a long-term trend in the lake, and suggests that other factors, including nitrogen limitation, define the lake's phytoplankton assemblage. It should be noted that at the same time other lakes in the region had a phytoplankton community dominated by diatoms and green algae, and blue-greens were either non-existent or present in very low numbers. In May 2012, mid-depth algal abundance and biomass values were significantly lower than the respective surface water values. Similar to the surface waters, the diatoms were the dominant organisms.
During the 17 July sampling event, the blue-green were by far the dominant group in the surface

waters of Culver Lake in terms of abundance and biomass. The dominant blue-green algae in the surface waters were *Anabaena* and *Aphanizomenon,* while the dominant green alga was *Eudorina.* Mid-depth phytoplankton abundance was approximately two times less than the surface abundance; however biomass values were greater in the mid-depth waters than that at the surface. Similar to the surface samples, blue-green algae were again the dominant genera identified in the samples collected at mid-depth, with *Coleosphaerium* the dominant species in terms of biomass and abundance. The green algae species composition identified in the mid-lake samples were similar to that measured in the surface samples, although at a much reduced abundance and biomass.

As discussed above in May surface and mid-depth chlorophyll *a* concentrations were no greater than 18.4 mg/m^3 (Table 3) and the lake's Secchi depth clarity was 1.9 meters. This is in keeping with the relatively lower phytoplankton densities measured in May, although the lake was dominated in the phytoplankton community by blue-greens. In July, the lake's chlorophyll a concentration, as measured at the lake's surface, was much higher than that measured in May at 46.9 mg/m^3 (Table 3). The lake's clarity was less and the lake had a pronounced green color in July as well. This is consistent with the dominance of the phytoplankton community by blue-green algae, which will tend to concentrate closer to the surface. The higher density of alga cells near the surface impacts the lake's aesthetics and makes the lake look worse. This was reflected in the July chlorophyll a levels.

Zooplankton diversity, densities and biomass were moderate during the 24 May 2012 sampling event. Surface and mid-depth zooplankton biomass values were somewhat similar to each other during the 24 May 2012 sampling event; however the number of zooplankton per liter was approximately 10% higher at the mid-depth location. This is due to a much higher amount of rotifers present at the mid-depth location. In contrast to conditions observed in May of 2004 – 2006, yet similar to 2008 and 2009, herbivorous zooplankton was non-existent in Culver Lake during the May 2012 sampling event. Only two cladocerans, *Bosmina* and *Chydorus*, were identified in the surface and mid-lake waters. However these species feed mainly on bacteria and detritus. No herbivores were identified in the mid-depth or surface waters. Rotifers were the dominant zooplankton at the mid-depth location while the copepod *nauplii* was the dominant zooplankton at the surface.

During the 17 July 2012 sampling event, one herbivorous zooplankton was identified in the surface and mid-depth waters of Culver Lake, *Ceriodaphnia.* However this herbivore made up only 3.0% of the total zooplankton abndance. In the surface waters the rotifers were the dominant zooplankton group in terms of abundance; with the rotifer *Conochilus* the dominant zooplankton in terms of biomass. In the mid-depth waters, the rotifers were the dominant zooplankton group in terms of abundance; however the copepod *nauplii* was the dominant zooplankton in terms of biomass. This trend has been observed the previous three years, where herbivores no longer accounted for a larger portion of the total zooplankton abundance.

The continued absence of herbivores is directly tied to the low number of grazable phytoplankton species present in the lake. The blue-greens, due to a number of reasons, are a poor food source for zooplankton. Thus, when such phytoplankton dominate the forage base, it is difficult for the lake's herbivorous zooplankton community to flourish. The low number of herbivorous zooplankton may also be the result of excessive grazing pressure by forage and/or young gamefish. The Association may wish to consider reanalyzing the lake's fishery in the next year or so.

To continue long-term efforts to facilitate the development of a zooplankton community dominated by large-bodied herbivorous genera in Culver Lake, approximately 200,000 total herbivorous zooplankton were stocked in Culver Lake during the May 2012 sampling event. Princeton Hydro will continue to observe this trend and adjust the stocking numbers accordingly.

5. AQUATIC MACROPHYTES (PLANTS)

During both the May and July site visits, Princeton Hydro conducted qualitative assessments of the lake's aquatic macrophyte (plant) community. In May a 50/50 mix of Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamageton crispus*) were the dominant species observed in both the Owassa Lake and Stehr Tract areas. The North Shore area also possessed a light sporadic mix of these two species. Finally, in the Causeway Cove area, a mix of Eurasian watermilfoil, curly-leaf pondweed and coontail (*Ceratophyllum demersum*) were observed, with heavier densities being closer to the Causeway Cove Bridge. Similar to the last few seasons, <u>no</u> tape grass (*Vallisneria americana*) was observed in the Stehr Tract, along the North Shore or at the mouth of the Causeway Cove Inlet.

In July, overall macrophyte densities in the Stehr Tract were lower relative to those observed in May. Sporadic patches of tape grass (*Vallisneria Americana*) were present while elodea (*Elodea canadensis*), curly-leaf pondweed, coontail and Eurasian watermilfoil were also observed, along with stands of water lilies (*Nymphaea spp.*), which tended to be growing close to the shorelines. The decreased densities of plants in this section of the lake between the May and July sampling events was due to the mechanical weed harvesting conducted by Aquatic Technologies during late June/early July. That harvesting effort reportedly removed 94-100 tons of plant material over the course of 52+ hours of machine operation. Specifically, the harvesting removed Eurasian watermilfoil, coontail, curly-leaf pondweed, elodea, tapegrass and lily species.

Elsewhere in the lake, during the July survey the only visible macrophyte species observed scattered throughout the North Shore areas were water lilies. However in the Causeway Cove section of the lake we observed a plant community similar is species and density to that of the Stehr Tract, which included tape grass, Eurasian watermilfoil, and secondary growth of curly-leaf pondweed. Similar to the Stehr Tract, hydroraking and harvesting operations were conducted in the Causeway Cove section of the lake in June.
Given the increase in the occurrence State-wide of water chestnut (*Trapa natans*) the Association

should aggressively survey the lake and educate boaters of the ecological dangers that this plant presents. This is a very insidious, invasive plant that is confirmed to be present in large numbers in a number of lakes in area including lakes in Sparta, Lake Musconetcong and Lake Wawayanda. Efforts need to continue to be taken to keep this plant out of Culver Lake.

6. SUMMARY

Sampling of Culver Lake was conducted in late-spring and mid-summer. To date, the quality of the lake was found to be for the most part consistent with the lake's established water quality thresholds. As noted above, Secchi Disk readings in May were well in excess of the 1 meter threshold value, however the July mid-lake reading was below the 1 m threshold, at 0.9 meters. In addition, the July DO data documented a lack of cold water fish habitat in both the metalimnion and hypolimnion of the lake. The DO measured at depths greater than 5 meters was <u>not</u> adequate enough to support trout, in fact the only optimal cold water fish habitat was really limited to a narrow band of the water column; between 4 and 5 meters.

The lake's temperature profiles showed signs of stratification in May, and by July thermal stratification was fully pronounced. However, thermal stratification is both expected to occur and is designed to occur by means of the operation of the hypolimnetic aeration system. As such, these conditions are relatively similar to the thermal seasonality and regimes of the lake observed over the past 9-11 years.

The lake's conductivity and pH values were relatively constant from surface to bottom in May, as could be expected given the stratified nature of the lake and the lack of extensive surface water warming. But in July, the pH of the surface waters had increased two orders of magnitude in comparison to the bottom waters. The observed difference was directly a function of increased phytoplankton densities and photosynthetic activity.

The blue-green algae were the dominant surface water algae present in the lake during the May sampling event. This trend continued in July as blue-green algae dominated the phytoplankton community of the lake, especially in the surface waters. This continues to be disturbing due to the various water quality impacts that can be caused by intense blue-green algae blooms. However, as evidenced by the lake's clarity, although blue green algae were dominant, at least through the July sampling date they were not creating any significant water quality or aesthetic problems. Based on a review of past weather patterns and the phytoplankton assemblage of the lake, it appears that in years where dry to drought conditions are prevalent through the early to middle parts of the growing seasons, the blue-green algae tend to dominate. Princeton Hydro will continue to examine the relationship between the phytoplankton assemblage and the seasonal weather pattern and will further document this relationship in the 2012 year-end report.

The complete results of the laboratory analyzed water sampling data are presented in Tables 3 and 4. Clarity is directly a function of algal densities, which can be assessed through the measurement of chlorophyll *a*. As noted above, a slight decline in water clarity was observed between the May (1.9 meters) and July (0.9 meters) sampling dates. With this reduction in clarity and the noted increase in blue green algae densities, the lake's clarity remained near the prescribed1.0 meter threshold, but in fact did drop below the threshold. Consistent with the higher May Secchi readings were relatively low chlorophyll *a* concentrations measured at both the surface (< 9.9 mg/m^3) and closer to the thermocline (18.4 mg/m^3) (Table 3).

TP concentrations throughout the upper portion and in the middle of the water column of the lake were somewhat elevated in May (0.03 mg/L to 0.05 mg/L) and minimal in July (0.02 mg/L). However, during both events, a significant increase in TP was measured in the lake's deeper water (0.29 mg/l in May and 0.16 mg/L in July). This is the result of internal recycling resulting from some sediment release as well as the accumulation of phosphorus released from decomposed plant and animal tissue.

In contrast to data collected during the monitoring years of the mid 2000's, the occurrence of herbivorous zooplankton was somewhat rare in Culver Lake. This was especially true in May, when this type of zooplankton should be flourishing. The low numbers of herbivorous is likely a function of a number of factors. First, blue green algae present a very poor food source for herbivorous zooplankton. Second, the low herbivorous zooplankton numbers may also be a sign of overgrazing by forage and/or young game fish. Third, although zooplankton stocking was conducted in May, the densities of introduced zooplankton were far less than that needed to supplement or "kick start" the lake's native herbivorous zooplankton community. Finally, in-lake habitat conditions may be responsible. However, it appears that ample refuge habitat exists as based on the lake's favorable DO/temperature profiles that fact that there is ample aquatic vegetation throughout the lake. Of the various factors we feel that the combination of poor food and overgrazing by planktivorous forage fish are responsible for the observed decline in herbivorous zooplankton densities. Princeton Hydro will continue to observe this trend and attempt to adjust the stocking numbers accordingly. IN addition, the Association may wish to reanalyze the lake's fishery in the next year or so.

Finally, in keeping with the lake community's commitment to control and limit the spread of invasive aquatic plants, the Normanoch Association must continue to be on guard for water chestnut (*Trapa natans*) and do all that can be done to prevent this plant from getting a foothold in the lake. Information is available through the Rutgers Agricultural Extension Services of Morris County's web site that can be accessed via: http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1119. Given the role of boating in the spread of this plant and the occurrence of water chestnut in a number of lakes in the proximity of Culver Lake, as well as the prime habitat that Culver Lake possesses for this species, continued boater education program should play a key role in the prevention of this plant's introduction in the lake.

TABLE 1

May 2012 *In-Situ* Data

In-Situ Monitoring for Culver Lake 5/24/12								
Station	**DEPTH (meters)**			**Temperature**	**Conductivity**	**Dissolved Oxygen**	**pH**	**Dissolved Oxygen**
	Total	**Secchi**	**Sample**	**(^{0}C)**	**(mmhos/cm)**	**(mg/L)**	**(units)**	**(%)**
Mid-Lake	**14.9**	**1.9**	**Surface**	20.15	0.188	8.76	7.88	96.5
			1.0	20.14	0.187	8.8	7.86	97.2
			2.0	20.03	0.186	8.95	7.82	98
			3.0	18.4	0.186	9.11	7.74	90.1
			4.0	16.15	0.186	8.72	7.64	87.7
			5.0	13.71	0.186	7.75	7.55	73.1
			6.0	12.5	0.187	7.32	7.49	66.2
			7.0	11.85	0.188	6.67	7.42	60.9
			8.0	11.22	0.189	6.62	7.38	60.6
			9.0	10.84	0.188	6.93	7.33	63
			10.0	10.61	0.189	6.56	7.29	58.1
			11.0	10.34	0.19	5.73	7.25	49.4
			12.0	10.01	0.194	3.7	7.14	31.8
			13.0	9.84	0.195	1.7	7.05	14.9
			14.0	9.72	0.201	<1.0	6.97	7.3
			14.5	9.63	0.201	<1.0	6.83	3.2
Stehr Tract	**1.5**	**1.5+**	**Surface**	21.77	0.152	7.67	7.68	87.4
			1.0	21.23	0.139	6.07	7.49	70.5
			1.5	19.54	0.185	2.79	7.34	33.1
Causeway Cove	**1.5**	**1.5+**	**Surface**	19.68	0.19	8.76	7.89	95.5
			1.0	19.21	0.187	8.62	7.83	91.1
			1.5	18.98	0.189	7.24	7.69	78.6
Inlet (RT. 206)	**N/A**	**N/A**	**Surface**	20.27	0.12	6.2	7.36	68.5
Inlet (Causeway)	**N/A**	**N/A**	**Surface**	21.53	0.186	6.22	7.58	68.3

TABLE 2

July 2012 *In-Situ* Data

In-Situ Monitoring for Culver Lake 7/17/12								
Station	DEPTH (meters)			Temperature	Conductivity	pH	Dissolved Oxygen	Dissolved Oxygen
	Total	Secchi	Sample	(^{0}C)	(µmhos/cm)	(units)	(mg/L)	(%)
Mid-Lake	14	0.9	Surface	27.39	202.6	9.17	9.68	125.9
			1.0	27.27	202.3	9.12	9.67	125.4
			2.0	26.71	200.2	8.78	9.17	117.7
			3.0	25.35	197.5	7.47	6.77	84.8
			4.0	20.73	192.9	7.04	5.1	58.6
			5.0	15.38	189.7	6.77	2.73	28
			6.0	13.59	189	6.62	1.78	17.6
			7.0	13.14	189.2	6.51	1.22	11.9
			8.0	12.88	189.3	6.47	1.01	9.8
			9.0	12.58	189.1	6.43	0.86	8.3
			10.0	11.91	188.7	6.43	0.83	7.9
			11.0	11.44	191.6	6.4	0.56	5.3
			12.0	11.01	193.1	6.41	0.42	3.9
			13.0	10.71	198.8	6.48	0.12	1.1
			13.5	10.23	215.5	6.49	0.09	0.8
Stehr Tract	1	1	Surface	27.55	200.1	7.71	7.46	97.3
			1.0	26.76	200.1	7.27	7.05	90.6
Causeway Cove	1.5	1.2	Surface	28.54	204.4	8.56	8.44	112
			1.0	27.98	206.3	8.08	8.02	105.4
			1.5	27.2	210.4	7.07	6.56	84.9
Inlet (RT. 206)	N/A	N/A	Surface	25.16	154.7	6.58	7.66	95.7
Inlet (Causeway)	N/A	N/A	Surface	30.85	223.9	6.36	7.53	103.9

Table 3 Discrete Water Quality Data Culver Lake - Mid-Lake Sampling Station 24 May 2012		
SURFACE (0.5 m)	**Chlorophyll *a***	9.9 mg/m^3
	NH3-N	0.03 mg/L
	NO3-N	0.16 mg/L
	TP	0.03 mg/L
MID (5.0 m)	**Chlorophyll *a***	18.4 mg/m^3
	NH3-N	0.03 mg/L
	NO3-N	0.15 mg/L
	TP	0.03 mg/L
DEEP (13.0 m)	**NH3-N**	0.55 mg/L
	NO3-N	0.29 mg/L
	TP	0.29 mg/L
CAUSEWAY COVE BROOK	**NO3-N**	0.20 mg/L
	TP	0.06 mg/L
	TSS	14mg/L
OWASSA BROOK	**NO3-N**	0.24 mg/L
	TP	0.05 mg/L
	TSS	ND <3 mg/L

Table 4 **Discrete Water Quality Data** **Culver Lake - Mid-Lake Sampling Station** **17 July 2011**		
SURFACE (0.5 m)	**Chlorophyll *a***	46.9 mg/m^3
	NH3-N	0.10 mg/L
	NO3-N	ND <0.02 mg/L
	TP	0.02 mg/L
MID (5.0 m)	**Chlorophyll *a***	17.0 mg/m^3
	NH3-N	0.06 mg/L
	NO3-N	ND <0.02 mg/L
	TP	0.02 mg/L
DEEP (13.0 m)	**NH3-N**	0.58 mg/L
	NO3-N	ND <0.02 mg/L
	TP	0.16 mg/L
CAUSEWAY COVE BROOK	**NO3-N**	ND <0.02 mg/L
	TP	0.03 mg/L
	TSS	5 mg/L
OWASSA BROOK	**NO3-N**	0.09 mg/L
	TP	0.06 mg/L
	TSS	ND <3 mg/L

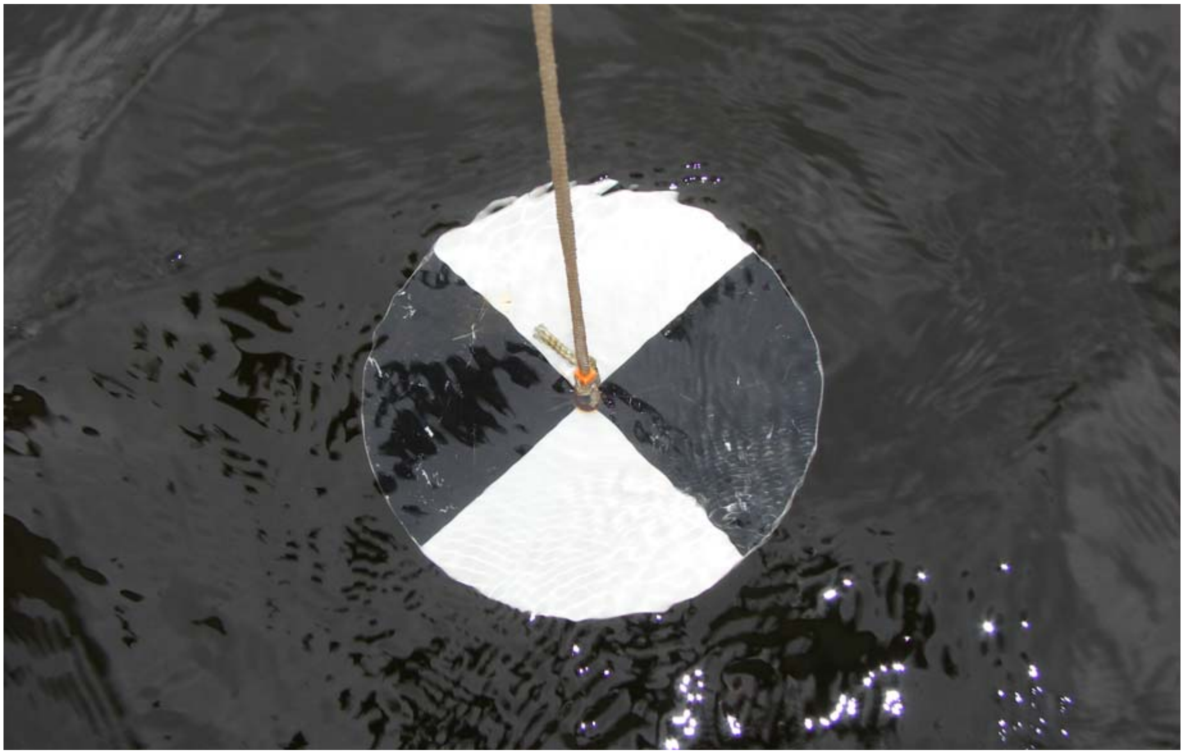

Photo 1: 24 May 2012 surficial view of the secchi disk.

Photo 2: 24 May 2012 view of the secchi disk at a depth of 1 meter.

2012 Water Quality Monitoring Program
Normanoch Association
Culver Lake
Township of Branchville, Sussex County, New Jersey
Project # 0013.020

Princeton Hydro

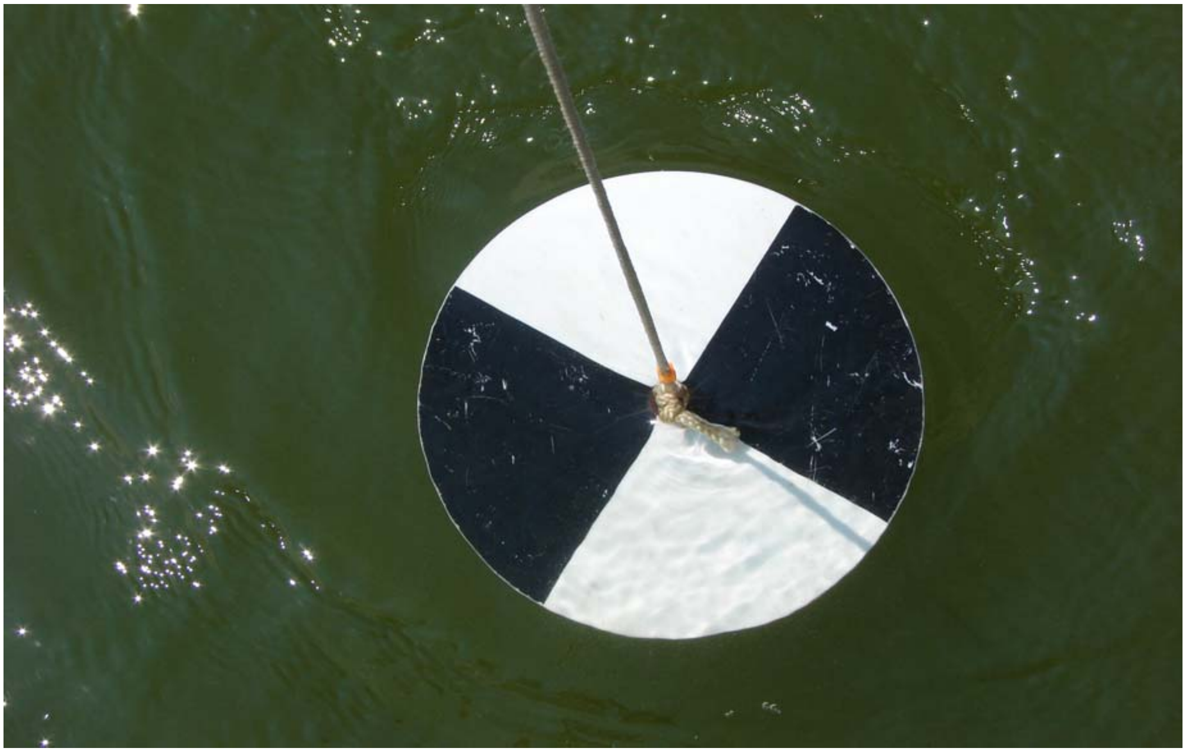

Photo 3: 17 July 2012 surficial view of the secchi disk.

Photo 4: 17 July 2012 view of the secchi disk at a depth of approximately 0.5 meters.