Amston Lake Management Report 2018

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Introduction

Amston Lake is a 188-acre lake in Hebron and Lebanon, Connecticut. Water quality monitoring of the lake began in 1994 and has continued annually since that time, with the exception of a couple of years in which monitoring was not conducted. This report presents findings of monitoring in 2018, and provides examination of aspects of the 25-year dataset (1994–2018).

Volunteer monitors conducted water sampling five times in 2018 – on May 30th, June 26th, July 30th, August 29th, and October 5th. The aquatic plants in Amston Lake were not surveyed in 2018.

Water quality in 2018 was much improved from last year's lake condition. Water clarity (Secchi disk depth) has been excellent for the last few years of sampling and was excellent again in 2018, ranging from 4.8 to 6.5 meters. The anoxic boundary remained much lower in the water column than in 2017 and while total phosphorus was slightly elevated in the bottom water, it also remained much lower than in 2017. Total nitrogen was also slightly elevated in the bottom water. The inlets to Amston Lake contained high nutrient concentrations which require investigation to locate sources of nutrients and implementation of fixes to remediate the loads.

Water Clarity

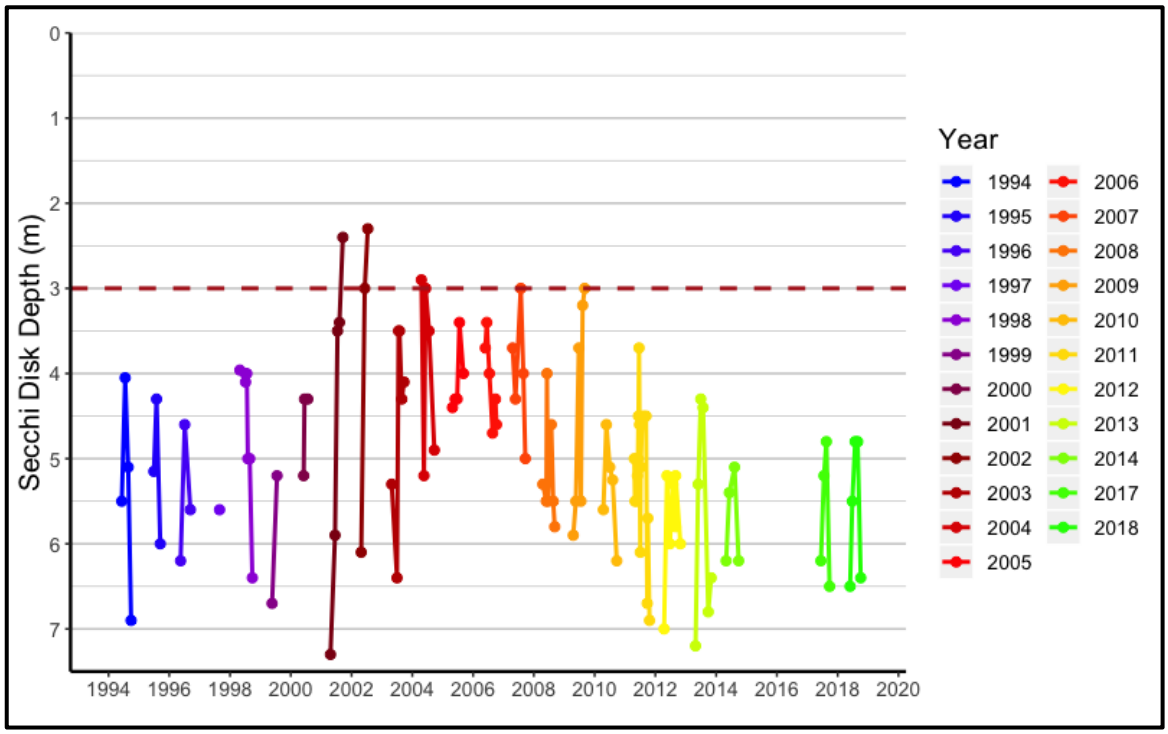
Water clarity (Secchi disk depth) has been documented several times per year from 1994 through 2014 and again in 2017 and 2018. No sampling was conducted in 2015 or 2016. From 1994 through 2000, water clarity remained >4 meters (**Figure 1**). In 2001, clarity declined to <3-meters. For the next eight years, water clarity declined to or just slightly below this 3-meter threshold. In 2010, clarity was much better, remaining well below the threshold for the duration of the season. Clarity has remained excellent for the past 6 years (although there was no data collection in 2015 or 2016).

The water clarity in 2018 was very similar to that from 2017. In May and October, clarity was excellent, with Secchi disk depths of 6.5 meters in both months (**Table 1**). In June, clarity was also good, at 5.5 meters. In July and August, water clarity was slightly worse, recorded at 4.8 meters in both months.

Table 1. Secchi disk depths (water clarity) in meters, 2018.

5/30/18	6/26/18	7/30/18	8/29/18	10/5/18
6.5	5.5	4.8	4.8	6.4

Figure 1. Secchi disk depths (m) between 1994 and-2018.



Dissolved Oxygen, and Nutrients

The water at the bottom of the lake was anoxic (devoid of oxygen) in June, July and August 2018 (**Figures 2** and **3**).

When the water at the bottom of the lake is anoxic, nutrients are released from the bottom sediment through the process of internal loading, leading to increased nutrient concentrations in the lake. These high nutrient concentrations are mostly confined to the anoxic water but as the anoxic water rises in the water column, it covers more of the surface area on the lake bottom, causing nutrients to be released from more of the lake's sediment. Thus, a higher volume of anoxic water generally leads to higher nutrient concentrations in the lake.

In 2017, the anoxic water rose higher in the water column than in any previous year, meaning that a greater portion of the lake water was anoxic. In 2018, the anoxic boundary remained much lower in the lake, not rising above 6.3 meters. As a result, nutrient concentrations in the bottom water also remained lower than in 2017.

The total phosphorus at the bottom of the lake was elevated for the entire 2017 sampling season, with some of the highest concentrations recorded in the past several years (**Table 2**). In 2018, phosphorus concentrations in the bottom water were much lower, remaining below 30ppb for the entire season, and only exceeding 20 ppb in July (**Table 3, Figure 4**). This suggests that while phosphorus is released into the lake from the sediment through internal loading, the nutrients remain in the bottom water, rather than moving upward in the water column when the lake mixes at the end of the season.

Long-term phosphorus concentrations in both the surface and bottom water are shown to be trending up over the period of sampling 1994-2018, as shown by **Figure 5** and **6**. During the period 1994-2000 1 meter phosphorus was generally well below the 10ppb threshold, during the next ten years phosphorus concentration was generally around 10ppb while in the years since 2010 phosphorus has been above 10ppb with several occurrences of much higher concentrations. Bottom phosphorus had shown few annual peaks of concentrations over 20ppb, but now it is common for bottom water to have much higher conventions

Total nitrogen (TN) concentrations in the lake were fairly good in 2018. TN remained below (but close to) 300 ppb at the top and middle of the water column for the entire sampling season, with the exception of the sample taken at the top of the water column in May (**Table 4, Figure 7**). In the bottom water, TN concentrations ranged from approximately 250ppb to 300pbb in May, July and October and were slightly elevated above 300ppb in June and August. Ideally, TN throughout the water column should remain below 300ppb (**Table 5**).

Figure 2. Anoxic boundary depths (m) between 1996 and 2018.

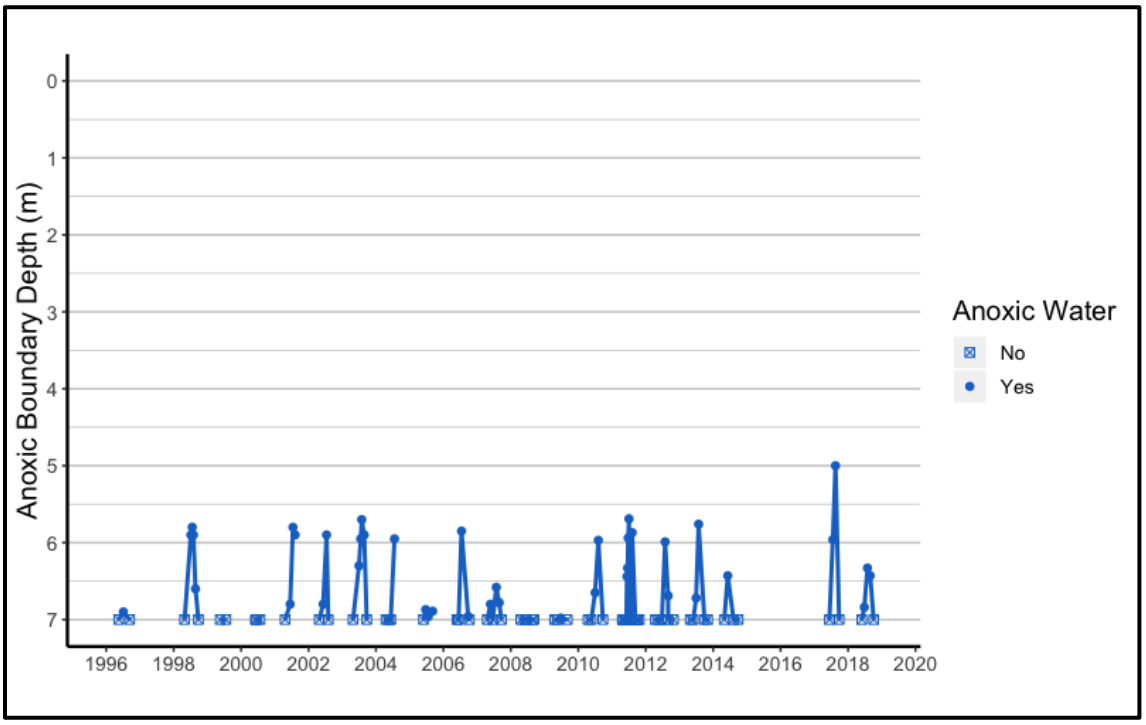


Figure 3. **Dissolved oxygen profiles (mg/L) in Amston Lake during 2018.**

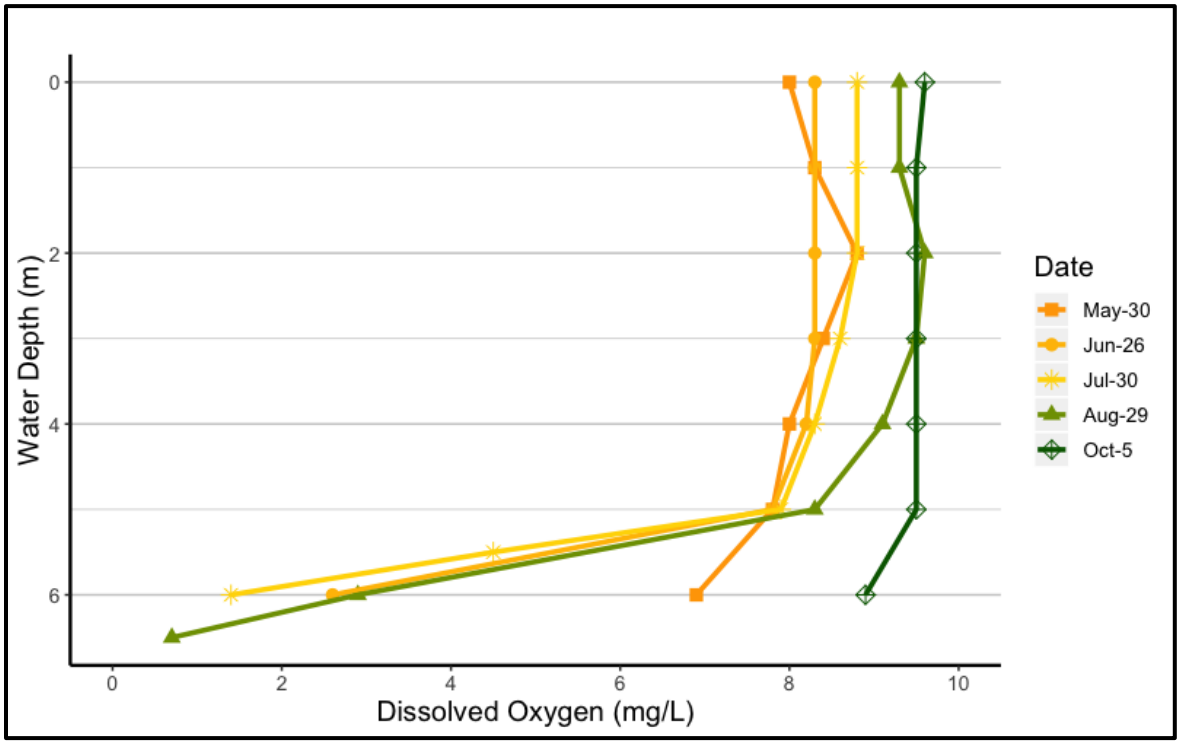


Table 2. **Yearly average and long-term average total phosphorus concentrations.**

	2013 avg.	2015 avg.	2016 avg.	2017 avg.	2018 avg.	Long-term
Top	19	18	9	11	11	13.6
Middle	16	11	11	11	13	12.4
Bottom	12	15	15	49	17	21.6

Table 3. **Total phosphorus concentrations in Amston Lake during 2018.**

	5/30/2018	6/26/2018	7/30/2018	8/29/2018	10/5/2018
Top	10	13	13	12	7
Middle	17	16	11	13	8
Bottom	14	19	26	18	6

Figure 4. Total phosphorus concentrations between 2013 and 2018.

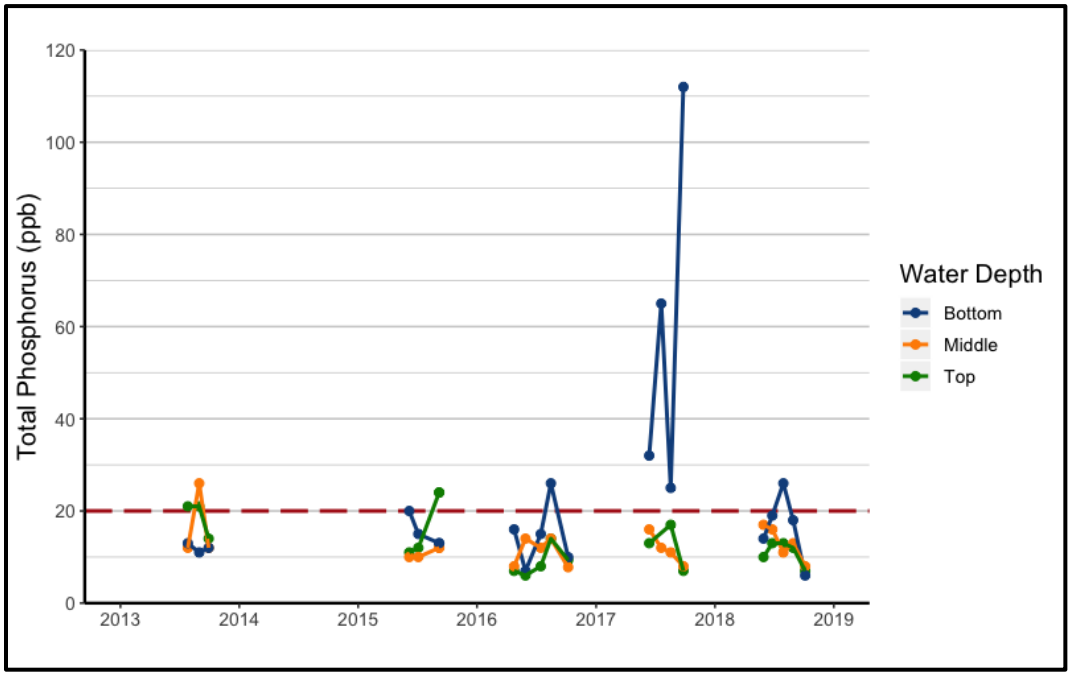


Figure 5. Total phosphorus concentrations at 1 meter depth between 1994 and 2018.

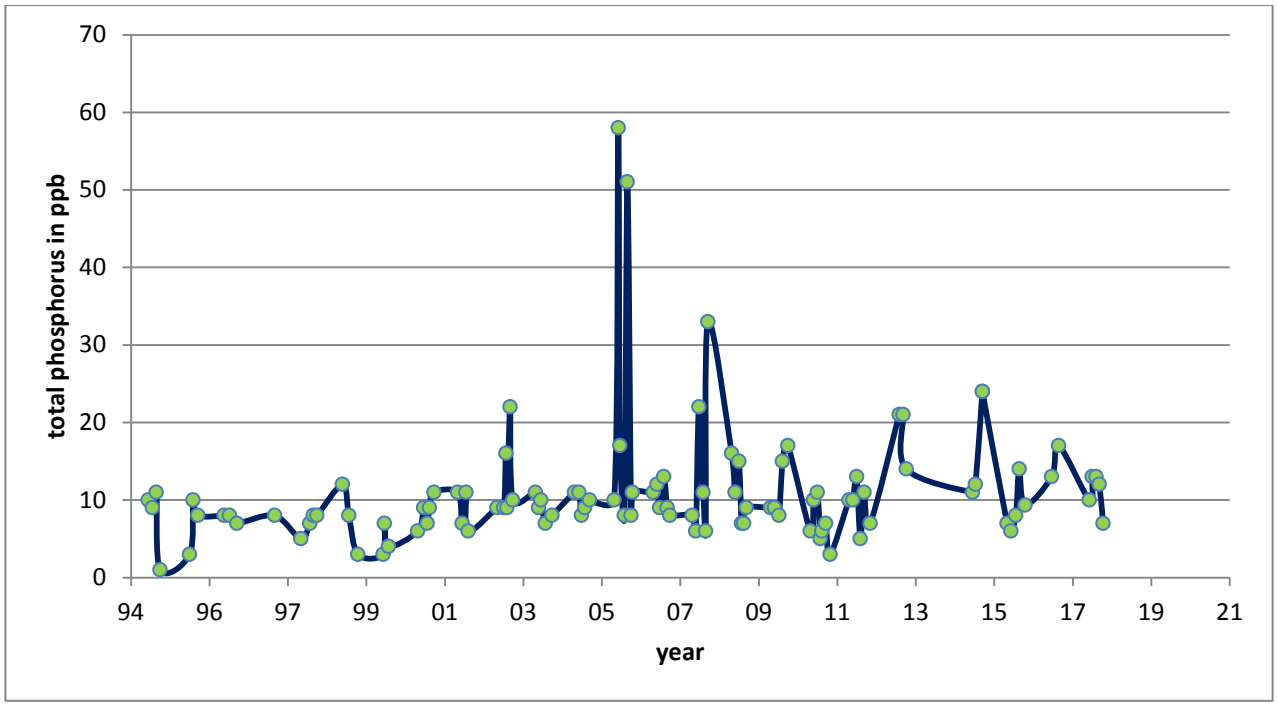


Figure 6. Total phosphorus concentrations at 6 meter depth between 1994 and 2018.

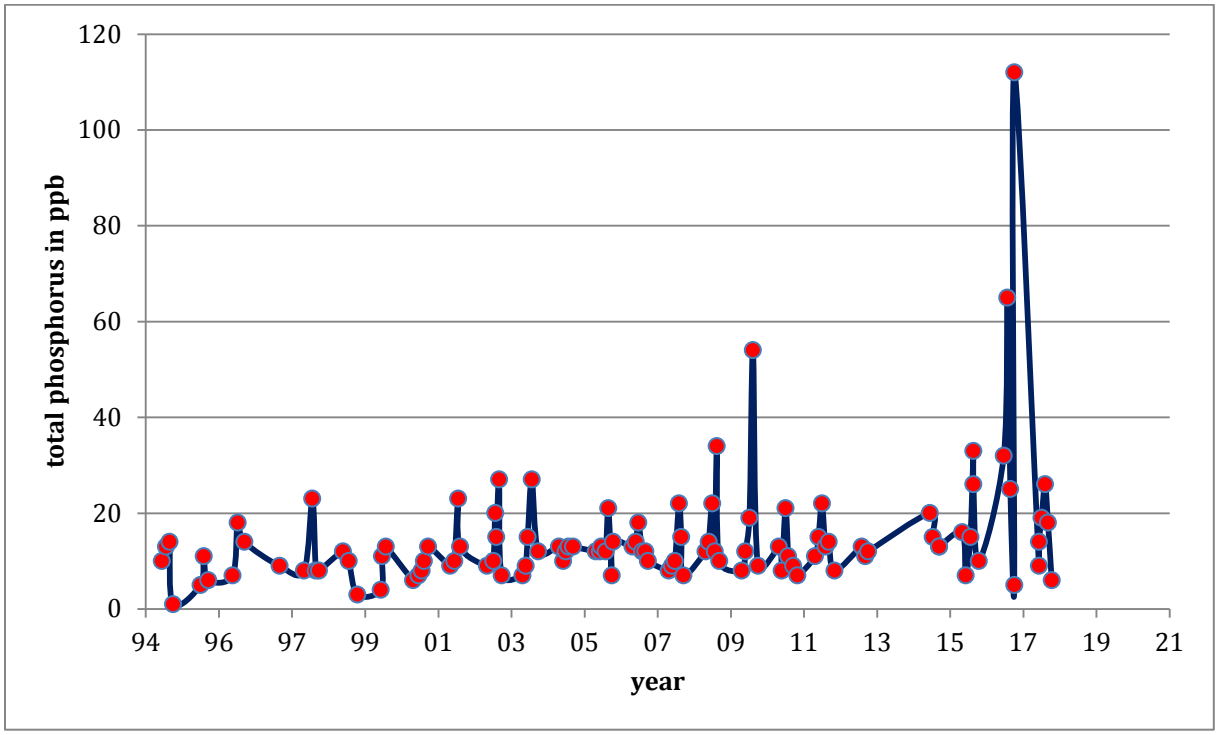


Table 4. Total nitrogen concentrations in Amston Lake in 2018.

	5/30/2018	6/26/2018	7/30/2018	8/29/2018	10/5/2018
Top	377	280	285	296	283
Middle	268	303	273	286	288
Bottom	258	343	257	392	295

Figure 7. Total nitrogen concentrations in Amston Lake in 2018.

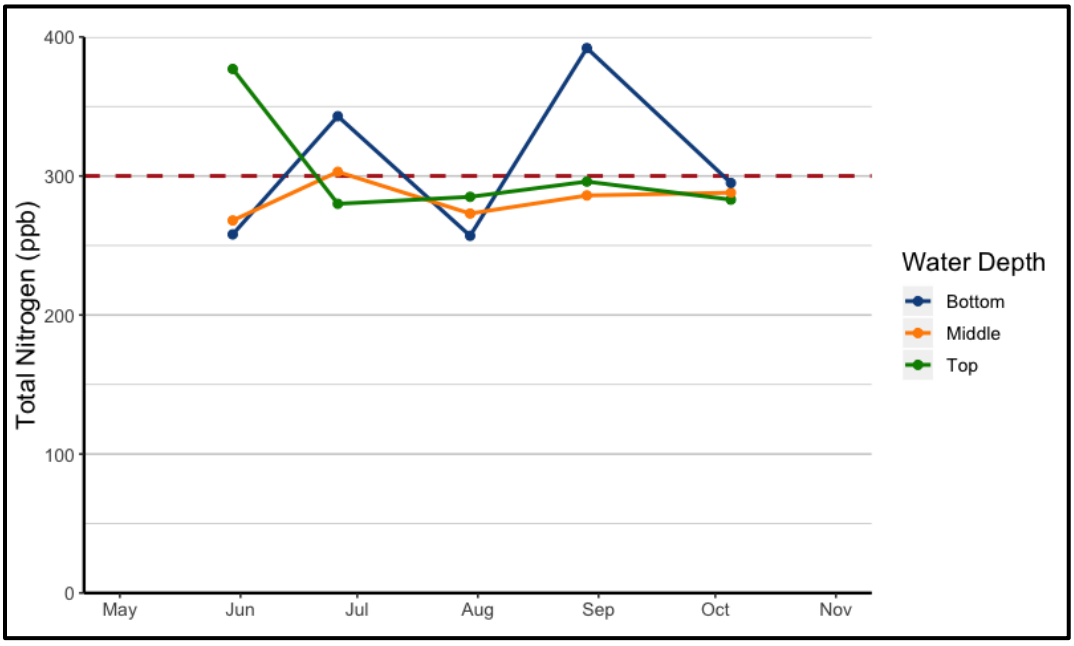


Table 5. Parameters and defining ranges for trophic states of lakes in Connecticut.

Lakes should remain on the left side of the red line to support Recreational Use	Trophic state=>	Oligotophic	Mesotrophic-	Eutrophic	Highly Eutrophic
	TP -ppb	0 - 10	10 – 30	30 – 50	>50
	TN -ppb	0 - 200	200 - 600	600 - 1000	>1000
	Secchi -meters	>6	6 - 2	2 – 1	<1
	Chlor.-*a* -ppb	0 - 2	2 – 15	15 – 30	>30

Inlets

The lake has a small watershed of 655 acres-with a drainage basin of only 473 acres, or about 2.6 times the area of the lake (**Figure 6**). The small drainage area provides slow hydraulic flushing of the lake, once every 435 days, or about 1.2 years. All inlet data collected in 2018 is given in **Table 9**.

Samples were collected from twenty-six individual inlets in 2018. A handful of these inlets maintain flow through the summer and were sampled several times from May through September.

Nitrate nitrogen (NO_X) concentrations in the inlets to the lake should not exceed 50ppb, total nitrogen (TN) should not exceed 200ppb. All inlets monitored for nitrate exceeded 50ppb, while the threshold in 2018 fro TN was exceeded most of the time (**Table 6)**.

Total phosphorus (TP) in the inlets should not exceed 50ppb. Nearly all 2018 inlet samples had TP concentrations above this threshold. Inlets with the highest TP levels (above 500ppb) are displayed in **Table 7**.

Water entering the lake via inlets should contain no ammonia (NH_3). However, all inlets samples collected in 2018 that were tested for ammonia contained the nutrient (**Table 8**). NH_3 concentrations exceeding 100ppb are an indicator of large scale ammonification occurring in the watershed and should be tracked down and fixed.

Figure 8. Amston Lake drainage basin.

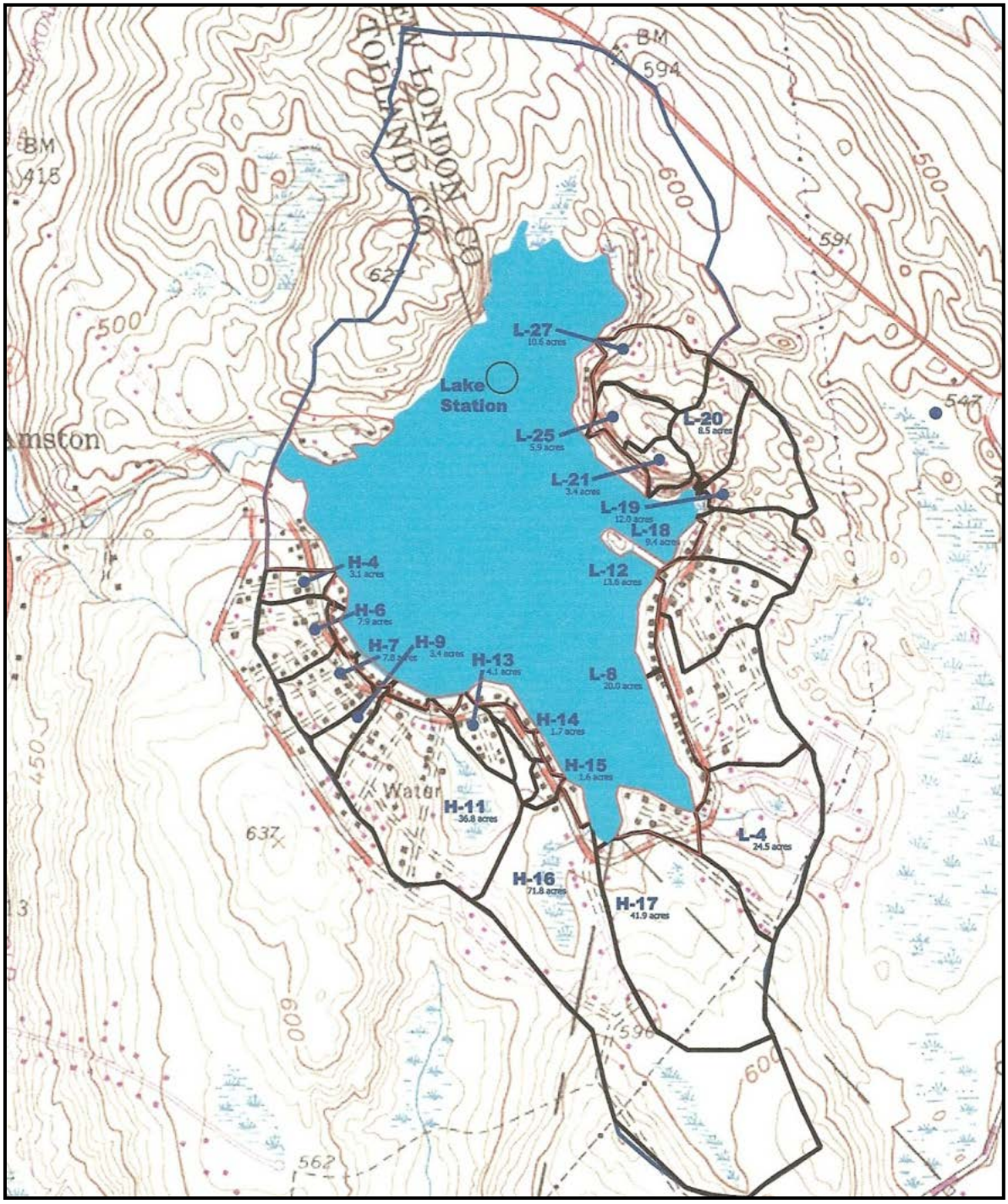


Table 6. Inlets with elevated nitrate nitrogen (NO_x) and total nitrogen (TN) concentrations (in ppb).

Inlet	Date	NOX	TN
H-4	4/25/18	NA	1,673
	6/4/18	NA	1,311
H-6	4/25/18	NA	2,688
	6/4/18	NA	3,961
H-15	6/4/18	NA	1,078
H-16	6/4/18	NA	1,073
L-12	4/16/18	1,020	NA
L-25	7/17/18	1,390	NA
	9/6/18	812	3,196
L-32	6/4/18	NA	1,365

Table 7. Inlets with very high total phosphorus (TP) concentrations (in ppb).

Inlet	Date	TP
H-4	4/16/18	618
	9/18/18	664
H-6	6/4/18	748
	9/18/18	612
H-11	3/16/18	748
	9/18/18	578
H-13	3/16/18	796
	9/18/18	766
H-17	9/18/18	664
L-12	7/17/18	772
L-19	7/17/18	610
	9/10/18	1,950
L-27	4/16/18	2,470
	6/4/18	538
	9/6/18	760
L-32	4/16/18	634
	6/4/18	684
	9/12/18	610

Table 8. Inlets containing ammonia (NH_3) in ppb.

Inlet	Date	NH3
H-4	9/18/18	41
H-6	9/18/18	129
H-7	9/18/18	36
H-9	9/12/18	8
H-11	9/18/18	32
H-13	9/18/18	11
H-16	9/18/18	149
H-17	9/18/18	26
L-4	9/12/18	68
L-12	9/10/18	40
L-18	9/10/18	28
L-19	9/10/18	180
L-25	9/10/18	259
L-32	9/12/18	110

Recommendations for 2019

- Monthly water quality sampling from April through October. Consistent sampling (at least once per month), as well as early and late season sampling is necessary to gauge the effects of lake stratification and mixing on the distribution of internally generated nutrients Sampling should include Secchi disk depth readings, temperature and dissolved oxygen profiles, and water samples from the top, middle and bottom of the water column.
- Inlet samples from all flowing inlets, collected monthly from early spring (during or immediately after snow melt) through October.
    - Aggressive watershed-wide clean-up is necessary for the long-term preservation of high quality water of the lake. Most inlets have very high phosphorus and nitrogen that needs to be controlled via best management using LID technology and fixes.
- One late season aquatic plant survey to document maximum growth of all aquatic plants in the lake. A few Invasive aquatic plant species are moving around the state and could find their way into Amston Lake.
- Year-end report documenting water quality and aquatic plants and providing recommendations for 2020.

Table 9. All inlet data collected in 2018.

Green shaded TP are Way Too High

Date	Site	NH_3	NOX	TN	TP	Turbidity
6/4/2018	CB			451	886	27.2
8/4/2018	CB_#6	97	138		246	42
8/4/2018	CB_#80	37	33		291	179
9/6/2018	CB_Out_#6		642	2849	970	67.3
7/17/2018	H11		NA		396	27.8
4/25/2018	H-11			674	24	
6/4/2018	H-11			729	144	11.7
9/18/2018	H-11	32	52		578	46
7/17/2018	H13		12		348	15.2
4/25/2018	H-13			428	115	
6/4/2018	H-13			591	248	31.9
9/18/2018	H-13	11	27		766	88.8
6/4/2018	H-14			804	184	15.6
6/4/2018	H-15			1078	372	15.9
4/25/2018	H-16			538	35	
6/4/2018	H-16			1073	359	49.2
9/18/2018	H-16	149	172		384	77.2
7/17/2018	H17		593		307	26.9
4/25/2018	H-17			295	52	
6/4/2018	H-17			452	102	15.4
9/18/2018	H-17	26	112		664	31.2
7/17/2018	H4		602		494	15.5
4/25/2018	H-4			1673	42	
6/4/2018	H-4			1311	59	8.6
9/18/2018	H-4_Elsmere	41	41		664	150
7/17/2018	H6		NA		186	14.6
4/25/2018	H-6			2688	180	
6/4/2018	H-6			3961	748	2.9
9/18/2018	H-6_Francis	129	101		612	52.8
7/17/2018	H7		704		518	5.4
4/25/2018	H-7			945	73	
6/4/2018	H-7			576	24	4.2
9/18/2018	H-7_Oakland	36	69		192	9.4
9/12/2018	H-9	8	4		159	5.1
4/16/2018	Inlet_CB_at_16		10		2.710	797
3/16/2018	Inlet_H-11		192		748	66.3

3/16/2018	Inlet_H-13		177		796	77.2
4/16/2018	Inlet_H-15		140		274	40.2
4/16/2018	Inlet_H-16		164		181	50
4/16/2018	Inlet_H-17		133		29	8
4/16/2018	Inlet_H-4		150		618	131
4/16/2018	Inlet_H-6		238		377	89.1
4/16/2018	Inlet_H-7		926		86	6.5
4/16/2018	Inlet_L-11		349		32	4.3
4/16/2018	Inlet_L-12		1020		48	16.9
4/16/2018	Inlet_L-18		558		16	4
4/16/2018	Inlet_L-25		262		107	18.3
4/16/2018	Inlet_L-27		12		2470	895
4/16/2018	Inlet_L-32		132		634	161
4/16/2018	Inlet_L-4		240		114	34.7
4/16/2018	Inlet_L-8		460		70	21.3
7/17/2018	L-12		938		772	513
9/10/2018	L-12	40	39		217	64.3
7/17/2018	L18		664		262	65.9
9/10/2018	L-18	28	30		149	32.7
7/17/2018	L19		356		610	24.5
9/10/2018	L-19	180	280		1950	216
7/17/2018	L25		1390		428	15.1
4/25/2018	L-25			815	32	
9/10/2018	L-25	259	219		157	3.4
4/25/2018	L-27			156	18	
6/4/2018	L-27			483	538	162
9/6/2018	L-27		812	3196	760	95.2
6/4/2018	L-32			1365	684	151
9/12/2018	L-32	110	379		610	9.9
9/12/2018	L-4	68	156		380	50.7
4/25/2018	Plunge_Pool			1376	5	
4/25/2018	Under_Driveway			1340	87	