



2022 Water Quality Report
Fresh Pond Reservation: Class B Ponds, Cambridge, MA
August 4, 2022

The Cambridge Water Department monitors three ponds on the Fresh Pond Reservation: Little Fresh Pond, Black's Nook, and North Pond (figure 1). Water quality samples from each pond are collected quarterly. These shallow ponds have no surface water connections to the Fresh Pond water supply reservoir, and as such, they have negligible influence over water quality in the Cambridge water supply. Gated pipes between Little Fresh Pond and Fresh Pond Reservoir are kept closed under normal operating conditions but are opened as needed in controlled conditions to supply irrigation water to Little Fresh Pond. All three ponds drain the City of Cambridge Municipal Golf Course and the reservation's wooded areas, with overflow connections to the City's storm drain system. Stormwater in the developed areas surrounding the reservation is diverted away to further protect drinking water quality at Fresh Pond Reservoir. Groundwater communication between the ponds, the surrounding developed area, and the reservoir is minimized by keeping the reservoir elevation higher than the water table. This report includes data from the reporting period of July 1, 2021 to June 30, 2022 (reporting year 2022).



Figure 1: Fresh Pond Reservation Waterbodies



Massachusetts Class B waters are designated for fish, other aquatic life and wildlife habitat, and for primary and secondary contact recreation. Class B water quality standards include numeric and narrative standards for dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor. In this study period, four dry-weather water quality sampling events were conducted. Samples were taken at the surface of each pond using extended poles or hand-grabbing samples after wading in from the shoreline. *In-situ* parameters were measured with a calibrated multi-probe concurrently with grab samples.

2022 Results

Black’s Nook- Listed in the 2016 Massachusetts Integrated List of Waters as a Category 5 impaired water for transparency/clarity, nutrient/eutrophication biological indicators, and non-native aquatic plants. The 2018/2020 Massachusetts Integrated List of Waters removed the non-native aquatic plants impairment and replaced it with an impairment specific to water chestnut (*Trapa natans*). However, recent studies conducted by the Cambridge Water Department indicate that, while non-native aquatic plants continue to be an issue at Black’s Nook, few if any water chestnut plants remain. The reduction in water chestnut density is the result of a multi-year volunteer effort to manually remove the invasive plant.

Three out of four Carlson’s trophic state index (TSI) numbers during reporting year 2022 were in the eutrophic or hypereutrophic range, although the chlorophyll-*a* (chl-*a*) result from the 8/11/2021 sample corresponded to a TSI in the mesotrophic range (figure 2, table 1). This indicates that productivity was high at Black’s Nook, a finding supported by an overgrowth of plants in the pond (photograph A).

1. Dissolved Oxygen (DO)

- Of the four surface DO measurements collected during the reporting period, three fell below the Class B standard (≥ 5 mg/L). Respiration from microbial organic matter decomposition and algae and plant growth likely contributed to the low DO concentration during the 8/11/2021 sampling event. Decomposition and a combination of decomposition and ice cover likely contributed to the low DO during the fall and winter events, respectively.

Date Below Class B Standard	Time	Result
8/11/2021	9:50 AM	1.31 mg/L
10/21/2021	10:15 AM	3.67 mg/L
2/10/2022	10:00 AM	2.58 mg/L

2. Temperature

- No exceedances associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3°C.



3. pH

- No excursions from the Class B pH range; all laboratory and field pH readings were between 6.5 and 8.3.

4. Bacteria

- All four *E. coli* samples were collected more than 30 days apart. Each sample was compared individually against the Class B 30-day rolling geomean water quality standard of 126 colony forming units (cfu/100mL) and the 30-day statistical threshold value (STV) of 410 cfu/100 mL (no more than 10% of samples may exceed 410 cfu/100mL in a 30-day period). Although the 30-day period may be extended to 90-days outside of the bathing season, CWD opted to conservatively compare results against the rolling geomean and STV values for the 30-day window year-round.
- No sample exceeded the 30-day geomean (126 cfu/100 mL) or the 30-day STV (410 cfu/100mL) standards.

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that floating aquatic vegetation might have presented conditions for impairment at Black's Nook on 8/11/2021. In addition, aquatic plant growth limited the potential for swimming and boating, though neither activity is permitted at Black's Nook (photograph A).

6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates that water bodies must be free from aesthetically objectionable conditions. Measured color and turbidity at Black's Nook were the highest of the reporting year on 2/10/2022 at 41 CU and 4.25 NTU, respectively (Table 1). During this sampling event, drilling through the ice with an ice auger may have disturbed sediment, confounding these results.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

Little Fresh Pond (LFP)- Not assessed as part of the 2018/2020 Massachusetts Integrated List of Waters survey. TSI values calculated from chl-*a* results ranged from oligotrophic in October (10/21/2021) and February (2/10/2022) to mesotrophic in August (8/11/2021) and May (5/26/2022) (figure 2). These results indicate that LFP is a moderately productive pond, with higher levels of productivity during the growing



seasons. The mesotrophic state in August 2021, as opposed to a eutrophic state, could have resulted from above average rainfall in July. This above average rainfall may have increased the flushing rate for the pond, keeping productivity slightly lower than usual during the growing season. Shoreline restoration, vegetated buffers, and a pretreatment swale and forebay system were completed in 2008. Specific conductance readings and sodium and chloride concentrations are consistently among the highest of the reservation ponds (table 1). The values for these parameters closely mirror those of Fresh Pond Reservoir, reflecting the hydrological connectivity via pipes and groundwater communication.

1. Dissolved Oxygen (DO)

- One sample during the reporting period fell below the Class B standard (≥ 5 mg/L). On 8/11/2021, a majority of the pond was covered in lily pads in addition to submerged aquatic vegetation (photograph B). High productivity on this date might have contributed to low respiration and DO.

Date Below Class B Standard	Time	Result
8/11/2021	9:15 AM	4.05 mg/L

2. Temperature

- No exceedances associated with warm-water fisheries were observed. The Class B standard requires temperatures not to exceed 28.3°C.

3. pH

- No excursions from the Class B pH range; all laboratory and field pH readings were between 6.5 and 8.3.

4. Bacteria

- All bacteria samples were collected more than 30 days apart. There was one exceedance of the Class B *E. coli* 30-day geomean (<126 cfu or most probable number (MPN)/100mL for a single sample) but no exceedances of the 410 cfu/100mL STV. On 5/26/2022, the *E. coli* grab sample indicated 249 MPN/100mL. There are no sewer lines in the area of LFP, so the *E. coli* hit was likely from animal sources.

Date Above Class B Standard	Time	Result
5/26/2022	9:34 AM	249 MPN/100mL

5. Solids

- There are no numeric criteria for solids, but visual observations suggest that neither floating nor suspended solids were an impairment for LFP. However, aquatic plant



growth may limit the potential for swimming and boating at LFP, though neither activity is currently permitted for humans. Dogs are permitted to swim at LFP from a designated dog swim platform.

6. Color and Turbidity

- There are no numeric criteria for color and turbidity. However, the standard dictates water bodies must be free from aesthetically objectionable conditions. Aside from aquatic plant growth, CWD did not observe objectionable color or turbidity issues in the 2022 reporting year.

7. Taste and Odor

- No objectionable odors observed.

8. Oil and Grease

- No samples taken, but no visible oil and grease sheens observed.

North Pond- Not assessed as part of the 2018/2020 Massachusetts Integrated List of Waters survey. During the growing season, this pond fills with floating and rooted aquatic plants. Three of four chl-*a* results from the 2022 reporting year were consistent with a Carlson’s TSI for a highly-productive, hypereutrophic pond (figure 2). In February (2/10/2022), the TSI indicated an oligotrophic state. However, CWD drilled through thick ice to collect the February 2022 sample (photograph C). Clean melt water from the ice may have diluted the chl-*a* sample used to calculate TSI. North Pond still had the highest average and median TSI readings in the reporting period and was the most eutrophic of the three ponds (figure 2).

1. Dissolved Oxygen (DO)

- Three of four DO measurements collected during the 2022 reporting year were less than the 5 mg/L Class B minimum allowable concentration. Respiration of algae and plants could account for the low DO. Although low DO is less common in winter since cold water can hold more DO than warm water, and microbial respiration tends to slow down, the low DO could reflect the high organic matter load and microbial respiration during decomposition. CWD also drilled through a thick layer of ice to collect the February (2/10/2022) sample (photograph C). The ice may have restricted oxygen from the atmosphere from mixing with the water.

Date Below Class B Standard	Time	Result
8/11/2021	9:35 AM	0.13 mg/L
10/21/2021	9:45 AM	2.58 mg/L
2/10/2022	9:40 AM	3.27 mg/L



2022 Fresh Pond Reservation Class B Waters

2. Temperature

- No exceedances associated with warm-water fisheries were observed; temperature remained below 28.3 degrees C.

3. pH

- No excursions from the Class B pH range; all laboratory and field pH readings were between 6.5 and 8.3.

4. Bacteria

- All bacteria samples were collected more than 30 days apart. There was one exceedance of both the Class B 30-day *E. coli* geometric mean water quality standard (< 126 cfu or MPN) and the STV (410 cfu/100 mL). On 8/11/2021, the *E. coli* result was 1,300 MPN/100mL, which is high for the site and season. The high concentration might be due to favorable summer growth conditions following animal input, although no wildlife was observed during the sampling event

Date Above Class B Standard	Time	Result
8/11/2021	9:35 AM	1,300 MPN/100mL

5. Solids

- There are no numeric standards for solids. Visual observations suggested that mats of floating or suspended organic matter were a source of impairment for the pond that would discourage swimming and boating (if allowed) and created aesthetically objectionable conditions (photograph D).

6. Color and Turbidity

- The hypereutrophic state and water turbidity would discourage swimming and boating, although these activities are not currently permitted at North Pond; during the summer, North Pond becomes choked with aquatic vegetation and suspended organic matter impairing the water for those uses (photograph D). Measured turbidity was highest during the 10/21/2021 sampling event (12.9 NTU), likely due to decomposition of organic matter (table 1). Turbidity was also observed visually.

7. Taste and Odor

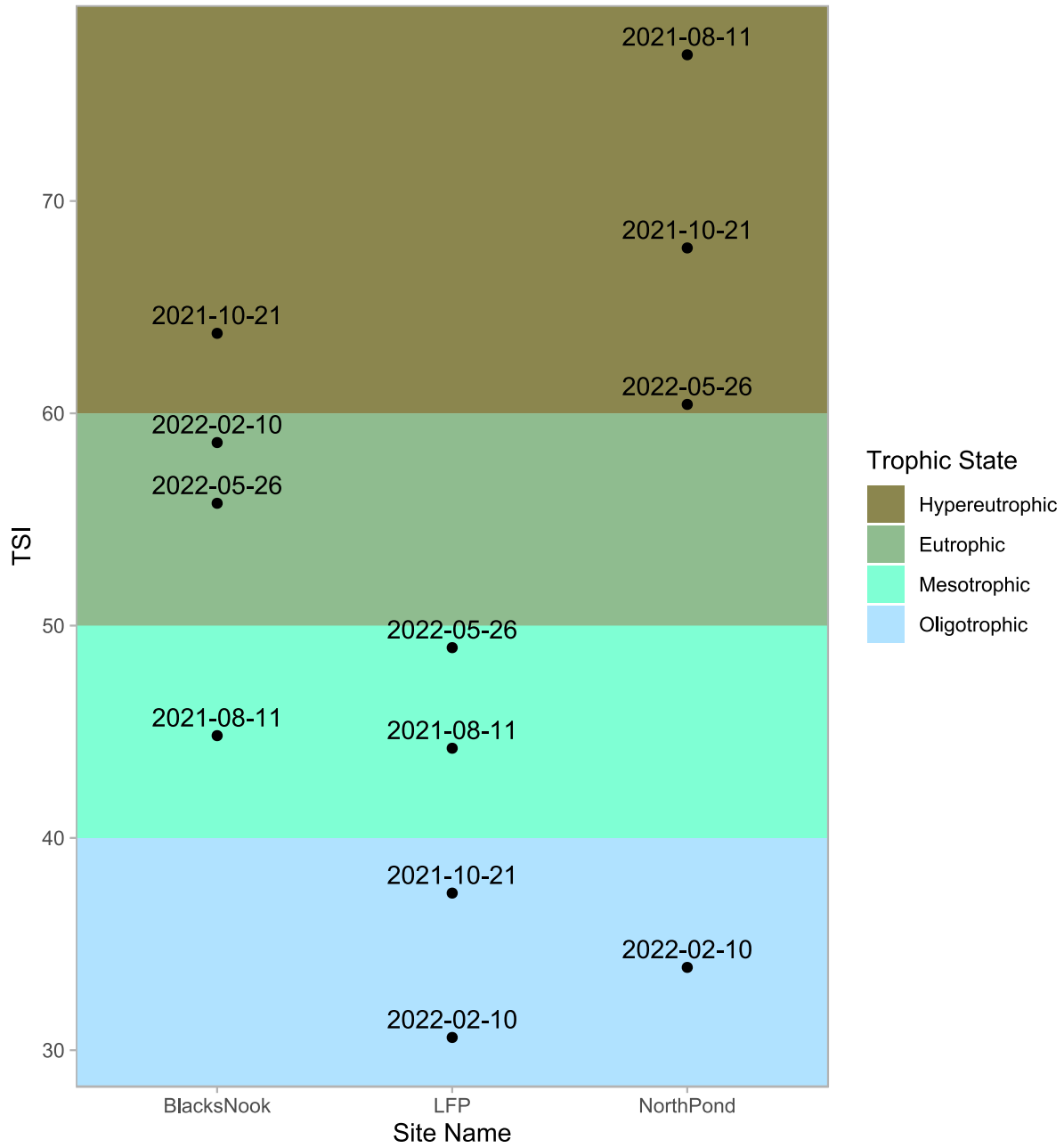
- No objectionable odors observed.



8. Oil and Grease

- No samples taken, but no visible sheens observed.

Figure 2: Reservation Pond Trophic State Index from Chlorophyll-*a*, July 1, 2021 – June 30, 2022





Photograph A: Blacks Nook, view looking northwest, showing dense macrophyte growth on 8/11/2021



Photograph B: Little Fresh Pond (LFP) looking southwest, 8/11/2021. Dense macrophyte growth is present around the edges of the pond, with submergent and emergent plants and some open water in the center of the pond.





Photograph C: North Pond, view looking south, showing thick ice cover on 2/10/2022



Photograph D: North Pond, view looking southeast, showing dense macrophyte growth, turbidity, and suspended solids on 8/11/2021





Table 1: Water Quality Results

Date	Site	Total Alkalinity (mg CaCO ₃ /L)	Al (mg/L)	Ca (mg/L)	Cl (mg/L)	Chl- <i>a</i> (mg/m ³)	Color (CU)	HDO (mg/L)	<i>E. coli</i> (MPN/100 mL)	Fe (mg/L)	Lab pH	<i>In situ</i> probe pH	Mn (mg/L)	Na (mg/L)
8/11/2021	Black's Nook	45.5	0.02	13.3	14.4	4.26	23	1.31	93	0.29	6.87	6.58	0.067	7
8/11/2021	LFP	47.25	0.02	21.95	147	4.01	16	4.05	65	0.225	7.52	7.15	0.0295	86.5
8/11/2021	North Pond	92.5	0.86	30.7	17.7	112	110	0.13	1300	7.75	7.03	6.74	0.999	11
10/21/2021	Black's Nook	47	0.08	17.1	13.3	29.4	21	3.67	11	1.29	6.89	7.09	0.151	10
10/21/2021	LFP	49	0.05	20	116	< 2	12	6.32	50	0.26	7.31	7.52	0.008	70
10/21/2021	North Pond	102	0.07	29.7	15.8	44.3	110	2.58	18	3.1	7.05	7.17	0.984	10
2/10/2022	Black's Nook	45	1.05	16.1	14	17.4	41	2.58	23	2.63	6.9	6.8	0.44	10
2/10/2022	LFP	27.5	0.18	10.6	58.8	< 1	24	12.53	7	0.35	6.81	7.6	0.044	36
2/10/2022	North Pond	49.5	0.1	14.7	7.2	1.4	68	3.27	61	1.4	6.79	6.93	0.353	5
5/26/2022	Black's Nook	46.5	0.06	16.1	13.2	13	35	7.35	10	0.83	7.3	7.22	0.173	8
5/26/2022	LFP	47.5	0.43	22.8	787	6.5	15	5.58	249	0.82	7.44	7.51	0.105	106
5/26/2022	North Pond	124	0.14	45.7	106	20.9	91	7.87	48	5.45	7.07	7.02	1.22	14



Table 1: Water Quality Results cont.

Date	Site	NH ₃ -N (mg/L)	NO ₃ -N (mg/L)	Lab SpC (uS/cm)	<i>In situ</i> probe SpC (uS/cm)	Total Dissolved Solids (mg/L)	Water Temperature (degrees C)	TKN (mg/L)	Total Organic Carbon (mg/L)	Total Phosphorus (mg/L)	Turbidity (NTU)
8/11/2021	Black's Nook	0.251	< 0.05	140	144.4	92.4	23.35	0.642	5.7	0.0638	1.03
8/11/2021	LFP	0.1285	< 0.05	600	623.7	399.2	23.98	0.4335	3.5	0.01485	0.72
8/11/2021	North Pond	0.347	< 0.05	237	254.2	162.7	22.65	2.3	13.4	0.313	7.72
10/21/2021	Black's Nook	< 0.05	< 0.01	128	145.4	93	15.28	0.525	6.4	0.0818	1.51
10/21/2021	LFP	0.0847	< 0.01	506	541.4	346.5	15.63	0.359	3.4	0.0138	0.57
10/21/2021	North Pond	0.243	< 0.01	234	258.6	165.5	14.33	1.44	12	0.117	12.9
2/10/2022	Black's Nook	< 0.3	< 0.042	123	145.6	93.2	1.82	1.1	6.2	0.15	4.25
2/10/2022	LFP	< 0.3	0.27	234	290.9	186.2	0.7	< 0.07	4.5	0.054	1.98
2/10/2022	North Pond	< 0.3	0.11	112	192.8	123.4	1.51	1.1	7.2	0.1	6.12
5/26/2022	Black's Nook	< 0.1	0.023	121	144.3	92.4	21.32	0.59	6	0.094	2.64
5/26/2022	LFP	< 0.1	< 0.01	598	704	450.6	20.09	0.77	4.6	0.063	0.85
5/26/2022	North Pond	< 0.1	< 0.01	279	325.3	208.2	19.46	2.7	14.6	0.21	11.7