BELLEAU LAKE

2021 SAMPLING HIGHLIGHTS

Station – 1 Deep

Wakefield, NH

Extension

Station 1 Deep (Figure 7) was used as a reference point to represent the overall Belleau Lake water quality. Water quality data displayed in Tables 1, 2 and 3 are surface water measurements with the exception of the dissolved oxygen data that summarize conditions near the lake bottom.

Blue = Oligotrophic

Yellow = Mesotrophic

Red = Eutrophic

Gray = No Data

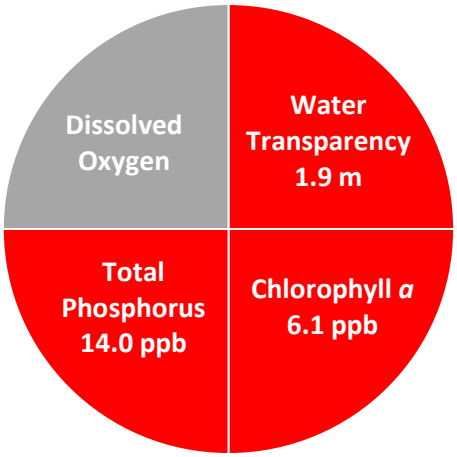


Figure 1. Belleau Lake Water Quality (2021)

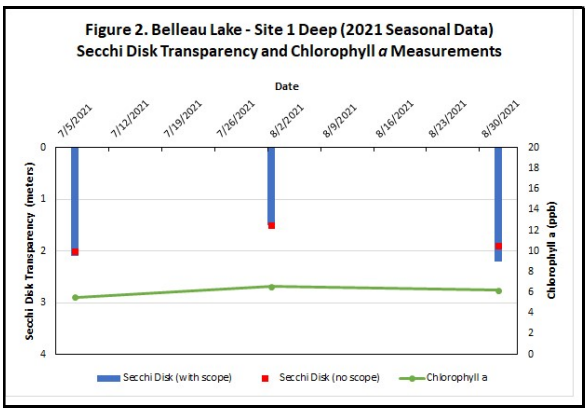
Table 1. 2021 Belleau Lake Seasonal Averages and NH DES Aquatic Life Nutrient Criteria[1]

Parameter	Oligotrophic	Mesotrophic	Eutrophic	Belleau Lake Average (range)	Belleau Lake Classification
Water Clarity (meters)	4.0 – 7.0	2.5 - 4.0	< 2.5	**1.9** meters (1.5 – 2.2)	Eutrophic
Chlorophyll *a* [1] (ppb)	< 3.3	> 3.3 – 5.0	> 5.0 – 11.0	**6.1** ppb (5.5 – 6.6)	Eutrophic
Total Phosphorus [1] (ppb)	< 8.0	> 8.0 – 12.0	> 12.0 – 28.0	**14.0** ppb (12.4 – 16.1)	Eutrophic
Dissolved Oxygen (mg/L)	5.0 – 7.0	2.0 – 5.0	<2.0	Not Assessed	Not Assessed

*Belleau Lake did not develop a deep water layer that is the basis for the dissolved oxygen classification criteria.

Table 2. 2021 Belleau Lake Seasonal Average Accessory Water Quality Measurements

Parameter	Assessment Criteria					Belleau Lake Average (range)	Belleau Lake Classification
Color (color units)	< 10 uncolored	10 – 20 slightly colored	20 – 40 lightly tea colored	40 – 80 tea colored	> 80 highly colored	**64.0** color units (range: 47.0 – 75.3)	Tea colored
Alkalinity (mg/L)	< 0.0 acidified	0.1 – 2.0 extremely vulnerable	2.1 – 10 moderately vulnerable	10.1 – 25.0 low vulnerability	> 25.0 not vulnerable	**7.5** mg/L (range: 6.5 – 8.5)	Moderately vulnerable
pH (std units)	< 5.5 suboptimal for successful growth and reproduction		6.5 – 9.0 optimal range for fish growth and reproduction			**6.3** standard units (range: 6.2 – 6.5)	Sufficient for fish growth and reproduction
Specific Conductivity (*u*S/cm)	< 50 *u*S/cm Characteristic of minimally impacted NH lakes		50-100 *u*S/cm Lakes with some human influence	> 100 *u*S/cm Characteristic of lakes experiencing human disturbances		**65.7** *u*S/cm (range: 61.6 – 69.4)	Lakes with some human influence



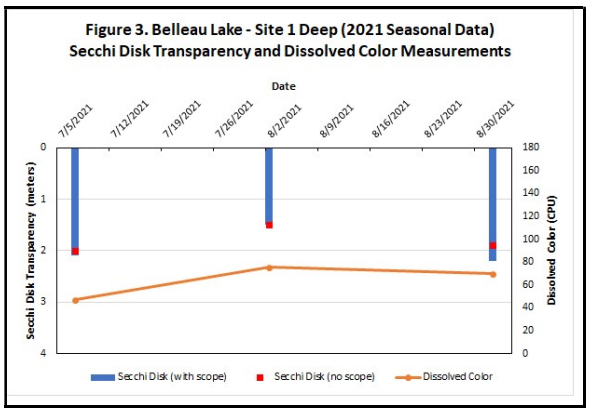


Figure 2 and 3. Seasonal Secchi disk transparency, chlorophyll *a* concentrations and dissolved color concentrations. Figures 2 and 3 illustrate the interplay among Secchi Disk transparency, chlorophyll *a* and dissolved color. Shallower water transparency measurements oftentimes correspond to increases in chlorophyll *a* concentrations. Secchi Disk transparency data are reported for measurements collected both with and without a view scope.

LONG-TERM TRENDS

WATER CLARITY: The Belleau Lake water clarity data, measured as Secchi Disk transparency, have oscillated among years between 2016 and 2021 (Figure 4).

CHLOROPHYLL: The Belleau Lake chlorophyll *a* concentrations, a measure of microscopic plant life within the lake, have been collected over a span of five sampling seasons between 2016 and 2021 (Figure 4).

TOTAL PHOSPHORUS: The Belleau Lake total phosphorus concentrations, the nutrient most responsible for microscopic plant growth, have been collected over a span of five sampling seasons between 2016 and 2021 (Figure 5).

COLOR: Color is a result of naturally occurring "tea" color substances from the breakdown of soils and plant materials. Belleau Lake color data have been collected over a span of five sampling seasons between 2016 and 2021 (Figure 5).

Note: data were not collected during the 2020 sampling season due to the COVID-19 pandemic and associated restrictions.

Figure 4. Belleau Lake - Site 1 Deep (2016-2021)
Long-term Secchi Disk and Chlorophyll *a* Data

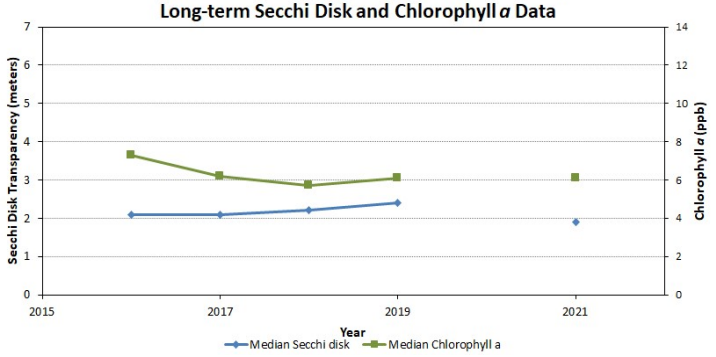


Figure 5. Belleau Lake - Site 1 Deep (2016-2021)
Long-term Total Phosphorus and Dissolved Color Data

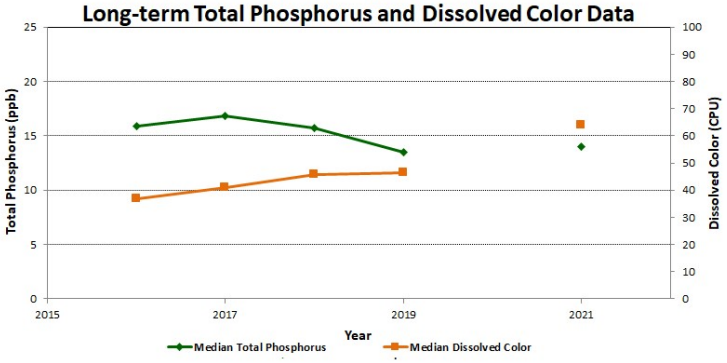


Table 3. Saco Watershed Headwaters Seasonal Average Water Quality Inter-lake comparison (2021)

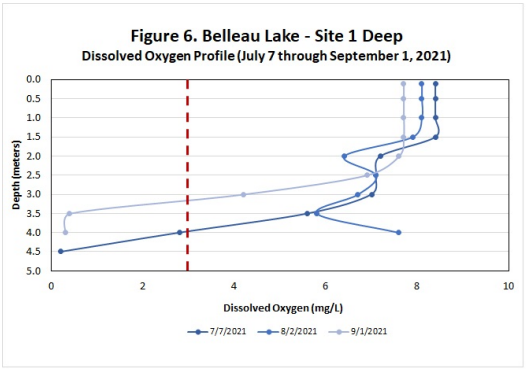
Lake	Average (range) Secchi Disk Transparency (meters)	Average (range) Chlorophyll *a* (ppb)	Average (range) Total Phosphorus (ppb)	Average (range) Dissolved Color (CPU)
Balch Lake	5.2 meters (range: 4.7 – 5.7)	3.3 ppb (range: 1.5 – 5.0)	8.4 ppb (range: 7.1 – 9.3)	35.3 CPU (range: 20.8 – 42.3)
Belleau Lake	1.9 meters (range: 1.5 – 2.2)	6.1 ppb (range: 4.5 – 8.7)	13.5 ppb (range: 12.7 – 14.7)	64.0 CPU (range: 47.0 – 75.3)
Pine River Pond	5.6 meters (range: 5.0 – 6.2)	3.3 ppb (range: 2.7 – 4.5)	1.7 ppb (range: 5.2 – 34.6)	18.6 CPU (range: 13.9 – 24.3)
Province Lake	3.6 meters (range: 3.0 – 4.9)	3.3 ppb (range: 2.6 – 4.1)	15.3 ppb (range: 1.6 – 17.9)	25.9 CPU (range: 21.4 – 31.4)

- Water quality data are reported for a deep reference sampling location in each water body

Figures 4 and 5. Changes in the Belleau Lake water clarity (Secchi Disk depth), chlorophyll *a* and total phosphorus concentrations measured between 2016 and 2021. **These data illustrate the relationship among plant growth, water color and water clarity. Total phosphorus data are also displayed and are oftentimes correlated with the amount of plant growth.** Long-term trends are based on the analysis of annual median values and will be displayed once 10 years of data are available for review.

Figure 6. Monthly Belleau Lake dissolved oxygen profiles collected between July 7 and September 1, 2021. The vertical red line indicates the oxygen concentration commonly considered the threshold for successful growth and reproduction of warm water fish such as bass and perch.

Figure 6. Belleau Lake - Site 1 Deep
Dissolved Oxygen Profile (July 7 through September 1, 2021)

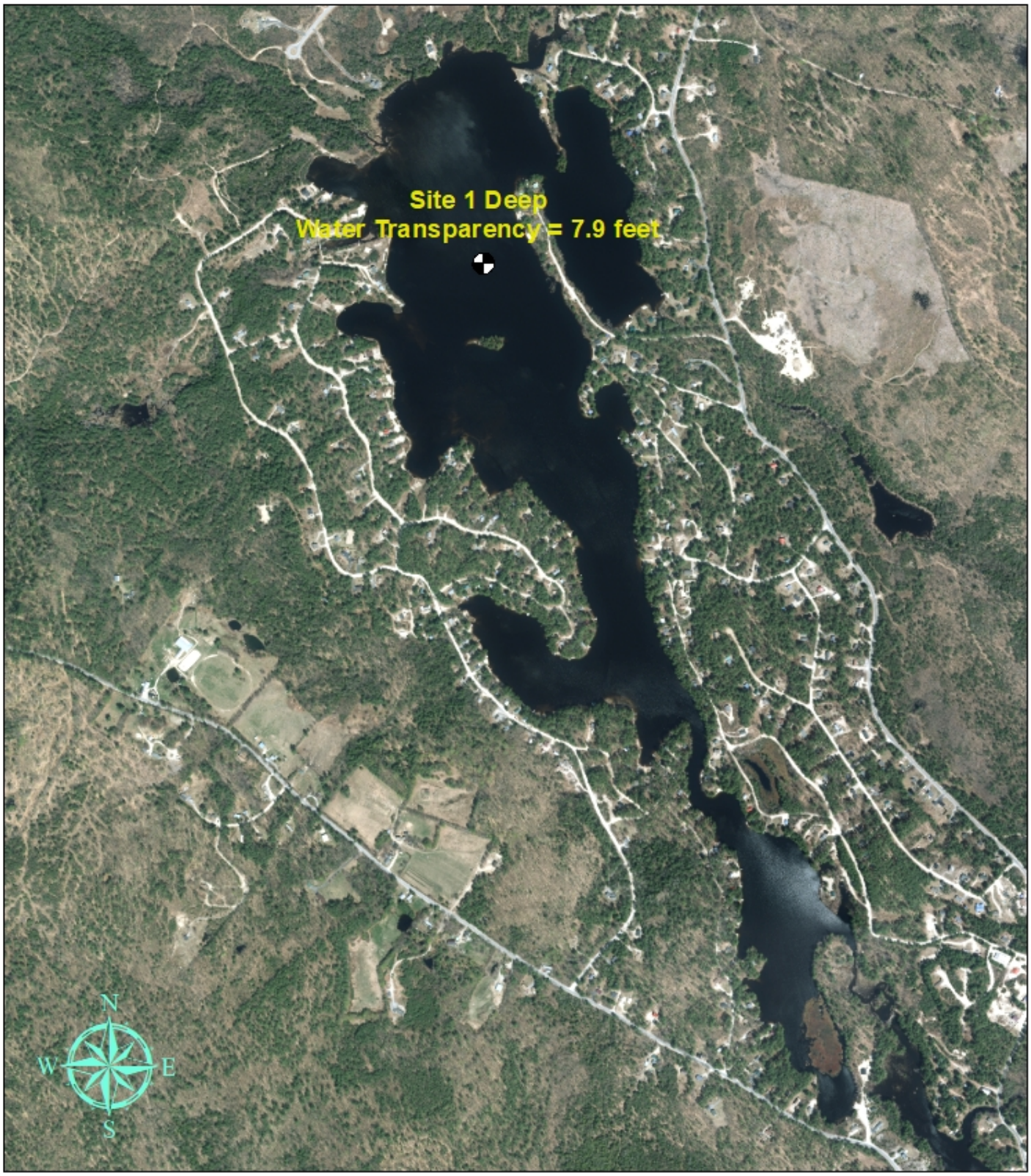


Recommendations

Implement Best Management Practices within the Belleau Lake watershed to minimize the adverse impacts of polluted runoff and erosion on the lake. Refer to "Landscaping at the Water's Edge: An Ecological Approach" and "New Hampshire Homeowner's Guide to Stormwater Management: Do-It-Yourself Stormwater Solutions for Your Home" for more information on how to reduce nutrient loading caused by overland run-off. The Acton Wakefield Watersheds Alliance also offers technical assistance to help design and implement erosion control project that protect water quality.

- https://extension.unh.edu/resources/files/Resource004159_Rep5940.pdf
- https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/homeowner-guide-stormwater.pdf
- https://awwatersheds.org/healthy-lakes/conservation-practices-for-homeowners/

Figure 7. Belleau Lake
Wakefield, NH
Deep sampling site and 2021 seasonal average water clarity



Aerial Orthophoto Source: NH GRANIT
Site location GPS coordinates collected by the UNH Center for Freshwater Biology