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December 20, 2021

Dennis Overfield
Co-Chairman
Rogers Lake Authority
119 Shore Drive
Lyme, CT 06371

Re: 2021 Summary of Rogers Lake Water Quality

Dear Mr. Overfield:

SWCA Environmental Consultants (SWCA) is pleased to provide a summary of water quality sampling completed within Rogers Lake for the 2021 season for the Rogers Lake Authority (RLA). As per our proposal, grab water quality samples were collected two times during the season and analysis of all results is provided in this document. The goal of the sampling and analysis is to provide information that will enable the Towns of Old Lyme and Lyme as well as the RLA to make decisions to improve the water quality, recreational value, and the aquatic habitat of Rogers Lake.

If you have any questions or require additional information, please do not hesitate to contact me by phone at (413) 658-2056, or via email at sfisher@swca.com.

Sincerely,

Scott Fisher
Director

Matt Lewis
Associate Project Restoration Ecologist

OVERVIEW

Water quality has been monitored within Rogers Lake since 2014. A Quality Assurance Protection Plan (QAPP) was developed in 2015 to ensure consistent water quality data collection standards throughout the project. The QAPP included a robust set of water quality standards to be assessed and a relatively frequent collection schedule and included an abundance of sampling across the entire depth of the lake. These data provided ample detail of changes in water quality across Rogers Lake.

Following a review of the 2019 Rogers Lake assessment report, lake and pond specialists determined that the frequency and quantity of sampling events within Rogers Lake should be reduced. This was determined based on the consistency of past water quality sampling results and is being implemented as a cost-savings measure. Therefore, the results described in the 2020 report were not precisely consistent with the developed QAPP but included the same water sampling analytes and provided the same analysis and summary of results. The 2021 report is consistent with the presentation and summary of data shown in the 2020 report except for the reduction from three sampling dates in 2020 to two in 2021. This was agreed upon by SWCA and the Roger Lakes Authority prior to the season.

In 2021 SWCA conducted two grab samples in the beginning and end of growing season on the following dates: May 24, and September 28, 2021. These two sampling events provide sufficient data to inform decision makers regarding water quality changes. A grab sample was collected at a shallow and deep sampling depth at each of the two deep pool locations within the lake.

1.0 WATER QUALITY SAMPLING

SWCA collected grab samples on May 24 and September 28, 2021. Samples were taken at predetermined locations within Rogers Lake (see Figure 1) at two different depths, which is sufficient for the monitoring program at Rogers Lake. At each location, one sample was collected at approximately 1.6 feet (0.5 meters) below the surface and the second was collected at approximately 1.6 feet from the bottom. The water samples were sent to SePRO Research and Technology Campus for analysis of the following parameters.

- Dissolved oxygen
- pH
- Conductivity
- Total phosphorus
- Orthophosphate
- Nitrite and Nitrate
- Total Kjeldahl Nitrogen (TKN)
- Alkalinity

Sample Site (SS) 1 is located just southeast of 116 Lake Shore Drive in a large open water portion of the lake with recorded depths of over 60 feet. SS-2 is in the southwestern portion of lake due west of 21−27 Rogers Lake Trail. Results of the water quality analysis from these two locations are summarized below and presented in Tables 1 and 2.

1.1 WATER QUALITY ANALYSIS RESULTS

The chemistry analysis of Rogers Lake at the shallow grab sample at SS-1 contained good water quality that is typical for freshwaters, as detailed in Table 1a. The pH was identified as near neutral (6.9 and 7.1 SU) on each sampling date, which is standard for freshwaters. The dissolved oxygen levels were also acceptable for fish and other aquatic life throughout the season (8.7 and 9.1 mg/L). Any recordings above 5.0 mg/L are deemed safe and acceptable for fish and invertebrates. For reference both dissolved oxygen results were higher than were observed in 2020 (6.0, 8.3, and 8.4 mg/L).

This location did have a low buffering capacity on each sampling date (10.1 and <10.0 mg/L as CaCO3). Recordings of 50 mg/L as CaCO3 or lower indicate the lake may be susceptible to shifts in pH. This is consistent to analysis in 2020 for this sample location; however, no instability was recognized within the water quality throughout 2021.The pH did vary slightly throughout the season but remained within the standard range for freshwater. The ionic concentrations were relatively low but typical of conductivity in freshwater ecosystems. In general, conductivity measures the ability of water to transfer electrical current. The temperature and concentrations of ions influence the level of conductivity. The warmer the water and higher the concentration of dissolved substances such as salts, chemicals, and minerals; the higher the conductivity. The visibility below the surface in this location was very good all season as it was 7.0 feet in both May and late September. Typical visibility management for swim management areas is a minimum of 4.0 feet below surface.

This location of the lake can be classified as mesotrophic, as it contains moderate levels of Total and Free Reactive Phosphorus. These values ranged from 14.4−16.3 ug/L throughout the growing season. Phosphorus presence is often an indicator of the potential for excessive growth of algae and nuisance plant populations. This data is a slight increase from 2020 but visual vegetative surveys throughout the season indicated that problematic plant and algae growth was generally low overall in 2021 and Rogers Lake contains healthy aquatic habitat. Nitrogen levels were considered low and typical of freshwater systems.

Table 1a: SS-1 Shallow Sample Results

Parameter	**5-24-21** taken 1.6 meters (3.6 feet) below	**9-28-21** taken 1.6 meters (3.6 feet) below	Notes
Dissolved O2 (mg/L)	8.7	9.1	Supports most aquatic life
pH (SU)	7.1	6.9	Near neutral –typical for freshwaters
Conductivity (µS/cm)	59.9	46.2	Typical of freshwaters
Total Phosphorus (µg/L)	14.4	16.3	Moderate-Mesotrophic
Free Reactive Phosphorus (µg/L)	5.0	<5.0	See Total Phosphorus
Nitrite (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Nitrate (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Total Kjeldahl Nitrogen (mg/L)	0.3	0.6	Low – typical of freshwaters
Alkalinity (mg/L as CaCO3)	10.1	<10.0	Low buffered
Secchi Deck (visibility below surface)	7.0	7.0	Acceptable for freshwaters

The deep sample at SS-1 maintained the same neutral pH throughout the 2021 season (6.7 SU). The dissolved oxygen levels were healthy and acceptable for fish and other aquatic life with readings of 8.2 mg/L on each sampling date. This location also had a low buffering capacity on each sampling although there was little shift in pH recorded. The ionic concentrations were low, but typical of conductivity in freshwater ecosystems.

This deep location of the lake is oligo-mesotrophic and maintains similar low to moderate levels of Total and Free Reactive Phosphorus to the shallow sample; ranging from 12.2−14.5 ug/L. Nitrogen levels were considered low and typical of freshwater systems. Overall, there are many similarities between the

shallow and deep samples form SS-1. The most marked difference is the marginally higher average dissolved oxygen content in the deeper sample than the shallow sample, which is to be expected.

Table 1b: SS-1 Deep Sample Results

Parameter	**5-24-21** Taken 38 feet below	**9-28-21** taken 33 feet below	Notes
Dissolved O_2 (mg/L)	8.2	8.2	Supports most aquatic life
pH (SU)	6.7	6.7	Near neutral –typical for freshwaters
Conductivity (µS/cm)	59.2	54.6	Typical of freshwaters
Total Phosphorus (µg/L)	12.2	14.5	Moderate-Mesotrophic
Free Reactive Phosphorus (µg/L)	5.0	<5.0	Acceptable for freshwaters
Nitrite (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Nitrate (mg/L)	0.1	0.1	Low – typical of freshwaters
Total Kjedahl Nitrogen (mg/L)	0.3	0.3	Low – typical of freshwaters
Alkalinity (mg/L as $CaCO_3$)	<10	11.5	Low buffered
Secchi Deck	n/a	n/a	Supports most aquatic life

The shallow sample at SS-2 also maintained a very consistent near neutral pH throughout the 2021 season (6.8−6.9 SU). The dissolved oxygen levels were healthy and acceptable for fish and other aquatic life with readings of 8.3−9.1 mg/L. This location also had a low buffering capacity on each sampling although there was little shift in pH recorded. The visibility below the surface in this location was good all season as it maintained 6.0 feet. This location of the lake is classified as in a mesotrophic state as it maintained similar low-moderate levels of Total and Free Reactive Phosphorus ranging from <14.1−15.1 ug/L. Nitrogen levels were considered low and typical of freshwater systems.

Table 2a: SS-2 Shallow Sample Results

Parameter	**5-24-21** taken 1.6 meters (3.6 feet) below	**9-28-21** taken 1.6 meters (3.6 feet) below	Notes
Dissolved O_2 (mg/L)	8.3	9.1	Supports most aquatic life
pH (SU)	6.8	6.9	Near neutral –typical for freshwaters
Conductivity (µS/cm)	61.2	51.1	Typical of freshwaters
Total Phosphorus (µg/L)	14.1	15.1	Moderate-Mesotrophic
Free Reactive Phosphorus (µg/L)	5.0	<5.0	Acceptable for freshwaters
Nitrite (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Nitrate (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Total Kjedahl Nitrogen (mg/L)	0.3	0.5	Low – typical of freshwaters
Alkalinity (mg/L as $CaCO_3$)	11	<10	Low buffered
Secchi Deck	6.0	6.0	Supports most aquatic life

The chemistry analysis of Rogers Lake at the deep sample of SS-2 contained a near neutral pH on May 24 and September 28 (6.5 and 6.6 SU) and the dissolved oxygen levels were observed as 8.4 and 7.7 mg/L, respectively. Both parameters are deemed acceptable for fish and other aquatic life throughout the season. This sampling location also had a low buffering capacity during each sampling event; however, like the other locations, the lake fluctuated very little in pH.

Like in 2020, this portion of the lake recorded the highest Phosphorus levels although they were not atypical of freshwater systems. The levels of 14.5 ug/L in May are considered low to moderate and consistent with all other sample locations, but 38.1 ug/L in September is relatively high and considered a eutrophic state. This high recording was late in the growing season and should not have impacted the water quality although it typically indicates a potential for higher levels of algae and plant growth. Nitrogen levels were low overall even though TKN on September 28 was recorded as having the most potential for harm (0.7 mg/L) of all the sampling locations, or most ability for an algae bloom to typically occur.

As stated in previous reports, SS-2 is adjacent to a long, steady decrease in water depth that leads to shallower water on the southwest shore of Rogers Lake that seems to accumulate organic matter. This area is potentially contributing decaying organic plant material to the deeper location of SS-2 which can release nutrients and impact the results of the sampling parameters at the end of the growing season.

Table 2b: SS-2 Deep Sample Results

Parameter	**5-24-21** taken 35 feet below	**9-28-21** taken 32 feet below	Notes
Dissolved O_2 (mg/L)	8.4	7.7	Supports most aquatic life
pH (SU)	6.5	6.6	Near neutral –typical for freshwaters
Conductivity (µS/cm)	63.1	73.1	Typical of freshwaters
Total Phosphorus (µg/L)	14.5	38.1	Moderate-Mesotrophic
Free Reactive Phosphorus (µg/L)	7.0	<5.0	Acceptable for freshwaters
Nitrite (mg/L)	<0.02	<0.02	Low – typical of freshwaters
Nitrate (mg/L)	0.1	<0.02	Low – typical of freshwaters
Total Kjedahl Nitrogen (mg/L)	0.3	0.7	Low – typical of freshwaters
Alkalinity (mg/L as $CaCO_3$)	11.6	23.6	Low buffered
Secchi Deck	n/a	n/a	Supports most aquatic life

2.0 CONCLUSION AND RECOMMENDATIONS

The water quality sampling data collected during the 2021 season indicates that the water quality of Rogers Lake is consistent and represents a typical healthy lake in New England. Overall, conditions indicate the water is classified in a mesotrophic state in all locations which typically relates to having a moderate amount of Phosphorus available and risk of algae growth. There was a mild increase to Phosphorus levels from 2020, but these results are consistent with previous water quality sampling. SWCA did not observed algae blooms during visual inspections of the water column in May and September. These continued results would indicate that Rogers Lake appears to be unaffected by annual vegetation management protocols and remains in good health.

SWCA recommends continuing this seasonal sampling protocol combined with the vegetative survey, as both provide thorough information on the current state of the lake.