Executive Summary

Limnological monitoring of the Rainbow Lake Chain has been carried out by the Rainbow Lake Association and the Adirondack Watershed Institute since 1997. This report serves as an update to the long term monitoring project by presenting the results of the 2017 field season and describing long term trends in the historical data of the Rainbow Lake Chain. Though the data and accompanying analysis provided in this report give insight into the water quality of the Rainbow Lakes, more detailed limnological studies may be necessary to produce management recommendations. Raw water quality data can be provided upon request. The bullets below represent the primary findings contained within this report.

- The dissolved oxygen profiles of the Rainbow Chain are typical of most lakes of moderate productivity in the Adirondacks, where dissolved oxygen is greatest in the epilimnion (surface water) and gradually decreases towards the bottom. Both Rainbow Lake and Clear Pond are significantly impacted by oxygen depletion in the bottom strata of the lakes. The oxygen depletion was clearly evident during our first visit in mid-June. By August, the bottom 8.5 meters (28 feet) of the deepest portion of Rainbow Lake had very low available oxygen, with the bottom eight meters (26 feet) being essentially anoxic (D.O. less than 0.5 mg/L). We observed a similar hypoxia/anoxia pattern in Clear Pond, but to a lesser extent than observed in Rainbow Lake. Lake Kushaqua exhibited oxygen depletion in the bottom water, but still retained at least 2 mg/L in late August. It is likely the bottom few meters of Lake Kushaqua also becomes anoxic by autumn.

- The transparency of Rainbow Lake typically fluctuates around 3 meters in depth and has not exhibited and positive or negative trend over the past 21 years. The transparencies of Clear Pond and Lake Kushaqua have both exhibited a slight yet significant downward trend over the monitoring period. We observed the transparencies Clear Pond and Kushaqua to be decreasing at a rate of approximately 4 cm/year and 8 cm/year respectively.

- Total phosphorus concentrations in the Rainbow Lake chain have been notably lower over the past 7 years. Some of the observed decrease may be related to improved analytical capabilities of the new AWI laboratory which went online in 2010. Since that time total phosphorus concentrations have been stable, with no significant trend detected in any of the lakes. Anoxic conditions in the bottom strata of Rainbow Lake and Clear Pond have resulted in elevated phosphorus concentrations near the bottom.

- Chlorophyll-concentrations in Rainbow Lake and Clear Pond chain have remained relatively constant over the 21 years of monitoring, generally fluctuating between 4 and 8 µg/L in Rainbow Lake and 2 and 6 µg/L in Clear Pond. We observed an increasing trend in chlorophyll-a concentrations in Lake Kushaqua since 2000.

- Carlson's Trophic Status Index based on transparency, chlorophyll-a, and total phosphorus suggests a mesotrophic classification for the three study lakes. The mesotrophic classification for the lakes has been consistent since the monitoring program began. In all of the lakes the TSI values for transparency and chlorophyll are in close agreement, however the TSI for total phosphorus tended to score the lakes in the oligotrophic range in some years. A disparity of this nature typically indicates that the lakes experience periods of phosphorus limitation.

- The waters of the Rainbow Lake chain are circumneutral in terms of their acidity (pH 6.5-7.5). The average alkalinity of the lakes ranged from 12-19 mg/L, indicating that the lakes were fairly well buffered, and as a result are not particularly sensitivity to acid deposition.

- Apparent color values of the lakes were elevated, and historically highly variable. Elevated color is indicative of high amounts of dissolved organic matter in the water and is typically due to watershed characteristics such as wetland, bogs, and coniferous forest cover. Lake Kushaqua is the most highly stained lake in the chain, with color values nearly double those found in Rainbow Lake and Clear Pond.

- Non-impacted Adirondack Lakes have very low levels of sodium and chloride, the only substantial sources being road salt, septic output, and industrial fertilizers. For example, Adirondack lakes in watersheds without paved roads typically have sodium and chloride concentrations less than 0.55 mg/L and 0.24 mg/L respectively. (Kelting et. al 2012). Rainbow and Kushaqua Lakes have slightly elevated concentrations of these chemicals compared to non-impacted baselines. The paved roads in the watershed along with shoreline development were likely responsible for the slightly elevated levels of these chemicals. No statistical trend was detected in the historic chloride levels in the Rainbow Lake chain.