October 25, 2013

Mr. Rick Gainar
Rome Rock Association, Inc.
1875 U.S. 6
Rome, OH 44085

Re: Late Summer 2013 Water Quality Sampling

Dear Mr. Gainar:

As directed by you and the Lake Management Committee, EnviroScience, Inc. (ES) performed beach sampling for Harmful Algal Bloom (HAB) toxins on August 22, 2013 and lake sampling for water quality purposes on August 29, 2013. This report summarizes these survey efforts and results.

Scope of Work

The objectives of these samplings were to:

1. Sample beach areas for toxins associated with harmful algal blooms (HABs) to insure that the community isn't being exposed to these potent toxins
2. Conduct water quality sampling at one, deep-water area of the lake to build on the existing water quality database and to compare current lake conditions to previous years.

Results

Samples for toxin analysis were collected on August 22, 2013 at the two main swimming beaches, with the beach located near the Clubhouse being designated as Beach Area 1 and the beach at Morningstar Park being designated as Beach Area 2. Samples were collected from these areas and analyzed by Lake Superior State University's Water Quality Lab for the three most common toxins, microcystin, cylindropspermopsin and saxitoxin. The results of these analyses are shown in Table 1. below.

It is noted that all sample results are below action levels identified by Ohio EPA's Division of Surface Water.

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Table1. ELISA Analysis of Lake Roaming Rock Beach Samples

Sample Lot Number:	Analysis Date	Concentration Microcystin (ug/L)	Concentration Cylindrospermopsin (ug/L)	Concentration Saxitoxin (ug/L)
Beach Area 1	8/28/2013	<0.16	<0.05	0.03
Beach Area 2	8/28/2013	<0.16	<0.05	<0.02

On August 28th water quality samples were collected at the approximate deepest portion of the lake, using a Kemmerer sampler capable of collecting discrete samples at various depths. A near surface sample was collected at each location at a depth of one meter. The surface sample was analyzed for nitrate, total organic nitrogen, total suspended solids, fecal coliform and total phosphorus. Mid-depth and near-bottom samples were also collected and analyzed for total phosphorus and each sample was also analyzed in the field for temperature, pH, conductivity and dissolved oxygen using a YSI ® multi-parameter water quality monitoring device. The device was calibrated according to the manufacturer's recommendations prior to use.

Table 2. Water Quality Results from August 29, 2013 Sampling

Depth (m)	Temp (°C)	Conductivity umhos/cm	D.O. mg/L	pH (S.U.)	Total Phosphorus (ug/L)	ortho-phosphate (ug/L)	Total Kjeldahl Nitrogen (mg N/L)	Nitrate (mg/L)	Total Suspended Solids (mg/L	Chloro-phyll a (ug/L)
0.5 (surface)	24.7	0.177	6.25	8.10	27.5	11.0	1.14	<0.1	21.0	19.12
16 (mid-depth)	20.0	0.191	0.02	6.64	40.5	17.0	1.19	0.01	20.0	4.19
33 (bottom)	11.3	0.260	0.03	5.95	489.5	21.0	2.69	0.02	15.0	4.65

Secchi Depth = 0.826 m

The results for temperature, conductivity and pH were within expected ranges and are conducive to aquatic life. Surface dissolved was adequate, but as noted in earlier surveys conducted by EnviroScience and others, DO drops dramatically below 5 meters in depth and approaches zero at mid-depth and the bottom of the lake as the summer progresses. The low DO conditions at the sediment/water interface result in a release of phosphorus and metals such as iron and manganese from the sediments to the water column. As noted in Table 2, total phosphorus levels rise dramatically near the bottom of the lake.

Carlson's Trophic State Index (TSI) (Carlson, 1977) is a relatively simple way of comparing these three measurements. Chlorophyll *a* (CHL), Secchi depth (SD), and total phosphorus (TP) are used in the TSI calculations to independently estimate algal biomass. Each individual measurement is converted to an index value ranging from 0 to 100 using the following equations:

$$TSI_{(SD)} = 60 - 14.41\ln(SD)$$
$$TSI_{(CHL)} = 9.81\ln(CHL) + 30.6$$
$$TSI_{(TP)} = 14.42\ln(TP) + 4.15$$

Based on its TSI values, a lake can be placed into one of four categories of trophic status: oligotrophic, mesotrophic, eutrophic, and hypereutrophic. **Oligotrophic** lakes (TSI <40) are typically clear, well oxygenated throughout, with little phytoplankton and low nutrient levels. **Mesotrophic** lakes (TSI between 40-50) are intermediate between oligotrophic and eutrophic lakes and are characterized by moderate clarity and nutrient levels, and increasing probability of anoxic conditions at depth during the summer. **Eutrophic** lakes (TSI between 50 and 70) are often characterized by a disappearance of oxygen (anoxia) in the deeper parts of the lake and nuisance levels of macrophytes and blue-green algal scums during the summer. **Hypereutrophic** lakes (TSI >70) have algal densities so high that light rather than nutrients becomes limiting to plant growth. Macrophytes often disappear because there is insufficient light to support their growth. Fish species shift towards roughfish that can tolerate low oxygen levels. In extreme hypereutrophic situations, winter and summer fish kills will occur.

TSI values calculated for Lake Roaming Rock from the August 29, 2013 sampling are as follows:

TSI_{CHLA} = 59
TSI_{TP} = 52
TSI_{SD} = 60

These values place Lake Roaming Rock near the high end of the eutrophic range and indicate that the lake is approaching hypereutrophic conditions. It is noted that these TSI values are slightly lower than those observed during EnviroScience's 2004/2005 water quality study, but it is difficult to draw meaningful conclusions given the very limited data set.

Conclusions

Steady inputs of phosphorus from what are likely agricultural sources in the watershed, coupled with increasingly significant internal loading of phosphorus from the sediment under anoxic conditions, contributes to significant eutrophication of the lake. This has resulted in more frequent blooms of nuisance and noxious blue-green algae. These blooms are not only aesthetically

unpleasing, but may also pose a number of problems if not addressed. These include:

- a reduction of sunlight in the water column making it more difficult for aquatic macrophytes to become established and grow;
- a general depression in dissolved oxygen levels caused by decomposition of algae as they decay, and finally;
- a direct threat to human health from algal toxins sometimes produced by these blue-green algae.

It is recommended that a routine summer monitoring program be in implemented in the future. Although sampling to date has revealed no apparent problem with HAB toxins, it is recommended that monthly monitoring for at least microcystin be implemented between Memorial Day and Labor Day. It is also recommended at a minimum that a late summer water quality sampling similar to that done this past August be performed to monitor in-lake nutrient concentrations.

Should you have any questions, or require clarification, please don't hesitate to contact me.

Sincerely;

Martin A. Hilovsky
President